ENGINEERING NEWS

GOV. HILL, of New York, has appointed Mr. MICHAEL RICKARD, a locomotive engineer on the New York Central, as a Railroad Commissioner, to succeed Mr. JOHN D. KERNAN, who has resigned. Mr. RICKARD was nominated last year for a similar position, but was not appointed. Personally we believe Mr. RICKARD to be an able and upright man, but we regret to see a man whose duties and experience have not at all tended to fit him for such delicate duties appointed to the responsible position of Railroad Commissioner. He cannot, in the nature of things, be well fitted for it, after spending a long life in the purely mechanical work of running a locomotive. His appointment is a mere demagogues' trick, pandering to the labor vote.

THE New York & Mass. R. R. Co., formerly the Poughkeepsie & Eastern R. R., is sueing the Poughkeepsie Bridge Co., through JOHN F. WINSLOW a stockholder in the bridge, to restrain the bridge company from building a new line practically parallel to that of the first named company. Mr. WINSLOW claims his interests will be injured by the projected route. But as Mr. COAN, the owner of the N. Y. & Mass. R. R., refused sometime ago to sell his road to the bridge company, and would only lease it on unsatisfactory terms, and the company have since abandoned negotiations and surveyed a line connecting with the Hartford & Conn. Western instead, the present move is looked upon simply as an attempt to force the bridge company to lease or buy the N. Y. & Mass. road.

THE New Croton Aqueduct Commissioners have sent in to Comptroller LOEW an estimate of $8,600,000 to meet the expenditures of the Commission in 1888. This amount is divided up as follows:

For work upon Section No. 1	$ 600,000
For work upon Sections 2 to 9, A and B, and section 12	2,600,000
For work upon Sections 13 and 15	450,000
For work upon Section 15 (Gate-house)	200,000
Head-houses to shafts, gate-house at Pocantico, etc., gate-house at Ardsley; highway bridge, Cut No. 8; Gould's Swamp adit, etc., gate-house at South Yonkers, Adit shaft No. 34, Pipe Line Section No. 16; East Branch reservoirs, dam, etc.; work on Quaker Bridge Dam	2,200,000
	$6,050,000
Commissioners' expenses for year	430,000
Ten per cent. amount reserved from work done	1,520,000
	$8,000,000

As has long been expected the contractors on the New Croton Aqueduct have now commenced proceedings on a claim of about $2,000,000 for "extras" arising from blowing down rock outside of the "normal section" of the aqueduct tunnel. The claim made is based on the filling put into this extra section by the contractors. This common source of dispute between engineer and contractor, promises to be interesting from the magnitude of the "extras" in this particular case.

THE final survey on the meeting of Shafts 2 and 3 on the New Croton Aqueduct, noted in our last issue, shows a divergence of only ¾ in. in the lines run from the two shafts 6200 ft. apart. The levels also come exceedingly close, but we have no exact data for them. Almost without exception the meetings of the headings on this now almost completed 30-mile tunnel have been so very close, both in line and level, that no better evidence is needed of the care exercised in running both the surface and underground lines. We hope later to present a list of these as soon as they are all verified.

As an offset to the rumors brought from Hon Kong, on Nov. 18, to the effect that the Chinese-American concession was cancelled by TSUNG LI YAMEN, *Bradstreet's* have a telegram from Mr. WHARTON BARKER to the following effect:—That the Chinese concession to the American syndicate for banks, telegraph, etc., remains intact, and that he has telegrams of a most encouraging nature from Shanghai two weeks later than the Hong Kong rumors brought on the *Belgic*, as first above quoted.

A FRESHET in Little river, Maine, on Nov. 15, carried away a part of one of the water company's dams at Belfast, and seriously damaged the bridge between Belfast and Northport.

IN last week's note on the fall of a portion of the ironwork and a derrick on the Union Elevated Railway, in Brooklyn, a slip in proof reading made us give the total weight of the material that fell as 250 tons. As only two 50 ft. plate girders and a part of the derrick suffered, the aggregate could not have been more than 50 tons as an extreme.

THE *London Economist*, of Nov. 12, says that Panama canal shares, which have steadily been declining for some time, suddenly dropped 16 f. 25 c. for money and 12 f. 50c. for the account, a few days before the date given. The closing price showed a decline of 25 f. since Nov. 1, and 32 f. 50c. since Oct. 15. The *Economist* says the weakness of the company is in paying dividends from capital and having its shares widely desseminated among small holders who cannot afford to wait for dividends. These small holders are now throwing their shares on the market.

AS Anglo-Russian politics may at any time bring the line into prominence, a description of the present condition of the English railway from the Indus towards Candahar may be interesting. From the Indus to Sibi, at the mouth of the Bolan Pass, there is one line built, but from Sibi to Quetta there are two lines. One is 100 miles long through the pass, and is rendered comparatively useless by a break in gauge from 5 ft. 6 in. to about 3 ft. The other is a loop line of broad gauge 156 miles long, *via* Hurnai. These two lines join at Bostan, 21 miles beyond Quetta. From Bostan a military road 24 ft. wide and with grades of 1 in 20 is under construction as far as Chaman, which is on the Afghan side of the Kwaya Amran mountain, and 70 miles from Candahar. The country beyond Bostan is difficult for railway construction, and the best route is only now being sought for and not yet determined. Railway material sufficient for the whole line to Candahar is now being accumulated at Quetta.

THE first piles were driven at the entrance to the new Manchester canal on November 11. The necessary plant for the commencement of the work is being accumulated and sidings are being put in.

THE growing necessity in England of using some form of car better adapted to branch lines which can afford little more than cheap plattorms at stations, and where the number of stations is great, bids fair to introduce a "modified form of the American car." The now recognized merit lies in the access to all parts of the train by the conductor and the collection of fares while the train is in motion. *Engineering* says that by this system "all station and signal charges would be abolished, and the expenses be reduced for train and permanent way." Why, of course; but Americans found that out forty years ago, and it applies to palace cars and "limited-express" trains quite as well as to poor local lines.

THE Russian tunnel through the Lesser Caucasus intended to connect with the Tiflis-Batoum line, is under construction, says the *Novoe Vremya*. At one end the tunnel is now driven 1,000 ft. and 200 ft at the other. The drills used are "of the latest description." The total length of tunnel will be over 2½ miles, and it is expected to be finished at the end of next year at a cost of about $5,000,000, including the loop line. Part of the tunnel is through clay and will require masonry lining, but the bulk of the tunnel is through hard rock. This tunnel, when completed, will eliminate the stiff grades over the Suram Pass, now worked by two 72-ton Fairlie engines, which can only haul 8 or 9 trucks at a time. To further relieve the present trouble the Russian Government has sanctioned the laying of 87 miles of oil pipe line over the Pass, and Messrs. NOBLE and ROTHSCHILD will lay down pipe lines of their own. This pipe will be supplied by either England, Germany or America, as Russia lacks facilities for manufacturing in time the large quantity required.

THE following bridge accidents are reported: On Nov. 18, a high trestle at Garrison's creek, about 8 miles east of Paducah, Ky., on the Chesapeake, Ohio & Southwestern Railroad, was burnt and gave way under a freight train, the entire train falling into the dry creek, 60 ft. below. Two men were killed and three injured. The wreck caught fire and several cars were burned. On account of the drought that section of the country has been in great danger from fire, and close watch is reported to have been kept over all the wood work on the road for several weeks. This trestle caught fire early in the morning and had been partly destroyed when the train came upon it.——On Nov. 19 a bridge on the Missouri Pacific Railroad, 2 miles east of Washington, Mo., was partially destroyed by fire, causing some delay to traffic.

THE most serious railroad accident of the week was a head collison Nov. 18, at Alvin Junction, 27 miles north of Galveston, Tex., on the Gulf, Colorado & Santa Fe Railroad. A south bound passenger train collided with a water train (another wild train accident) that was attempting to steal its way to a station 6 miles distant. Two men were killed and four injured, two fatally. The baggage and express cars were burned.——A construction train (still another wild train) on the Cleveland & Pittsburgh Railroad ran into a landslide which had buried the track at Backbone cut, near Steubenville, O. Two men were killed and the wrecked cars caught fire and were burned.——A freight train on the Canadian Pacific Railroad was wrecked Nov. 20, at the high level drawbridge over the Lachine canal, near the new Lachine bridge over the St. Lawrence. The draw was open but the train was not signalled. The whole train fell 60 ft. into the canal, which is 16 ft. deep. One man was killed and two injured. The accident was due to lack of interlocking apparatus. ——In a derailment of freight cars on the Western New York & Pennsylvania Railroad, Nov. 16, on a trestle at Silver Creek, N. Y., several cars *were kept on the trestle by the guard rail, till they reached the end, when one of them went down the bank.* Had the Latimer re-railing safety guard been in use on all the bridges and trestles of this road, as it is on many of them, the accident would not have occurred

ACTION in regard to steam heating of trains has been regretably slow, yet much has been already accomplished. A large number of trains in all parts of the country will run this winter with steam heat, quite enough to make it probable that by the end of the next winter any other form of heating will be the exception, which will be very rapid progress indeed for so great a reform. In saying this, we count upon the aid of a number of further holocausts during the coming winter to give further impetus to the reform, since they are quite sure to come, and each one of them to cause a much greater burst of public indignation than ever before.

As an example of what is doing to comply with the New York law that after May 1, 1888, car stoves must be banished, steam heat is already in on all the local trains of the Hudson River division of the New York Central, 15 in number, and on many others running west of Albany, and it is promised that the entire equipment will be refitted by next Fall. The Martin system is being used on this road, and seems to have the lead of any other. There is almost the same necessity for uniformity in steam heating as in air brakes, at least as respect the couplings, and we earnestly wish that some one form might become universal. But that end is as yet not in sight. A meeting of five leading lines held in New York a few days since to agree on something of the kind came to naught.

THE question of widening Elm street so as to give a new Broadway, parallel with and a little east of the old one, is being acted on as we write, with strong probability of favorable result. It would develop a region which is now in very backward condition, although so near to the best street of the city, owing chiefly to the wretchedly narrow and crooked streets, and it would be hard to imagine an improvement which has more in its favor and less against it. The most unfavorable result to be feared is an increase of the crush in Park Row, which is bad enough at best. A widening of Nassau or William street, to continue the improvement down to the lower part of the city, where it is still more needed, would be a natural sequence, and is also talked of, although in less forward state as a project.

Legal Injustice Toward a Railroad.

In a recent issue of the Bridgeport, Conn., *News* an incident is related which exemplifies very well the brutal pigheadedness with which the conduct of the public toward the railroads is sometimes characterized.

"A short time ago the railroad companies found it necessary to relay some of their tracks and frogs along Water street above South avenue, and also to adjust their curves at that point. They went ahead and had practically completed the work when it reached the ears of the Board of Public Works that they had encroached on the street line. Mindful of the years of trouble it had cost the city to get the railroads off this very line, there was no time lost in investigating the matter. On looking into it it was discovered that the tracks as relaid encroached on the street about a foot at the extreme point of the curve. The board at once notified the railroad people that they must move their tracks back where they belonged. There was argument and remonstrance in plenty, but it availed nothing. It was represented that the laying of the frog at that point called for more room and the railroad companies were obliged to have it. The board was inflexible. They said there was no reason why the frog could not be moved a few feet north. Finding arguments useless the frogs and tracks were all moved back to the proper line, and the city property was once more free from the encroaching tracks."

We have no further knowledge of the actual facts in the case than the above, but it is hardly likely that the railroad company would have gone to the expense and trouble of lining up the curve in question unless a considerable benefit was to result. Neither does it seem that any damage was done to any property by the slight change—12 ins. at the extreme point—that was made in the tracks. If there was injury done, we should be pleased to know its nature. The good old rule of "live and let live" is just as applicable to public as to private business; and when the letter of the law is mercilessly enforced upon the railroads, it is not surprising that they should demand the same interpretation when the advantage is on their side.

An Ancient Water Works.

Mr. ROBERT BASSEL, the technical attaché of the German Legation at Washington, is credited by the San Francisco *Call* with a description of the water works of Altatri, in Italy, which we have not before seen in print. This town of 10,000 inhabitants is in the foothills of the Abruzzi mountains, is 1500 ft. above the sea and is perched on an isolated peak that rises almost sheer 340 ft. above the surrounding plain.

An inscription preserved states that this town was supplied with water by one BETILIENUS VARUS, about 200 years before the Christian era, and the query has always been how he got the water on to this rock. Mr. BASSEL has been examining this region for the German Government and has solved the problem.

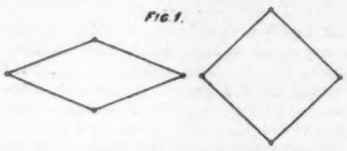
The source of the supply was in Cosa creek, some 20 miles from Altatri, and it was carried in an open canal following natural contours until it reached a precipitous descent about 7½ miles from the town and at a point higher than the town. Here the water was conveyed down the valley by leaden pipes, buried and covered with masonry and crossing a river by an aqueduct, and thence up the rock supporting the city. From the evidence of the pipe unearthed it is certain that either by theory or trial this engineer of 2000 years ago had arrived at the true proportions required for pipe under high pressure; and further that these pipes were cast vertically, as Mr. BASSEL found molds complete and the casting-heads. There were 7½ miles of this lead pipe; it had a constant internal diameter of about 4½ ins.; but in the part exposed to the heavy pressure it was 1.32 ins. thick, while it was only ⅛ in. thick in the upper portions. To further strengthen the pipe solid cores of a hard metal were put into the pipe and the lead was then hammered.

A STRIKING little example of the expense of grade crossings to railway companies is given in the annual report of the New Haven & Derby road. The gross earnings were $161,795; the operating expenses were $94,040, $4000 was paid out for damages by an accident at a grade crossing. Thus about six per cent of the net profits were absorbed by a single disaster.

The Pantograph; Its Theory and Its Use.*

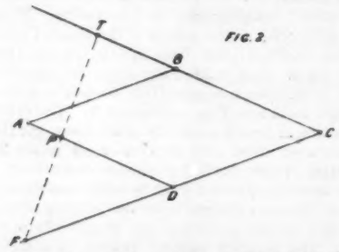
The principle underlying all the various constructions of pantographs is that of a parallelogram, jointed at its four corners, so that it can be brought into various shapes, as shown in Fig. 1. In all of

FIG. 1.



these shapes, however, the condition will be fulfilled that the sides opposite each other are equal and parallel to each other. Let *A B C D*, Fig. 2, represent such a parallelogram, two sides of which are prolonged beyond the joints at *B* and *D*. Let us suppose the point *F* to be held by a vertical pin, around which, as a fulcrum, the whole system can be turned, and again let us suppose a point *P* on the

FIG. 2.

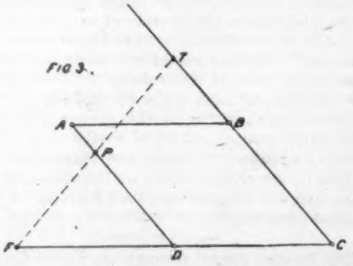


line *A D*, and a point *T* on the prolongation of the line *B C*, located in such a way that *F*, *P* and *T* are situated on one and the same straight line, then from the fact of *T C* being parallel to *A D*, we have

$$\frac{TF}{PF} = \frac{TC}{PD} = \frac{CF}{DF}$$

This proportion will remain unaffected if the parallelogram is shifted into a new position, such as shown in Fig. 3, by turning it around the fulcrum *F*, because the lengths *T C*, *P D*, *C F* and *D F* remain the same whichever way the system is turned around *F*. From the fact of this proportion holding

FIG 3.



good in any position of the parallelogram, it follows, according to well-known geometrical principles, that the three points *F*, *P* and *T* must continue to remain on one and the same straight line in all positions.

We have thus found that in any position into which we may bring the parallelogram by turning it around *F*,—*Firstly*, the proportion $\frac{TF}{PF}$ will always remain the same and be equal to $\frac{CF}{DF}$, and *secondly*, the three points *F*, *P* and *T* will always lie on one and the same straight line. These two facts contain the key of the theory of the pantograph, which we now enter upon by discussing the paths traveled by the two points *T* and *P* during the shifting of the parallelogram from its first into its second position.

In order to do this we will lay Fig. 2 on Fig. 3, for the sake of clearness, drawing the first one in heavy, and the second one in light lines. From the foregoing we have

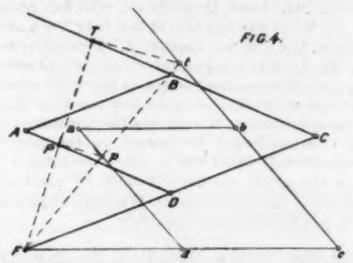
$$\frac{Tt}{PF} = \frac{tF}{pF} = \frac{CF}{DF}$$

and from this it follows, according to well know geometrical principles, that *T t* is parallel to *P p* and that

$$\frac{Tt}{Pp} = \frac{TF}{PF} = \frac{CF}{DF}$$

that is *the paths traveled by the two points T and*

FIG. 4.



P while the parallelogram is turned around F, are parallel to each other, and the proportion between them is constant and equal to the proportion between C F and D F.

It is easy to see that this will continue to hold good in the case of the paths being curves instead of straight lines as has been supposed here, because we can look upon such curves as polygons with very many and very short sides, to each of which the above deduction will apply.

If now we fix a tracing point at *T* and a lead pencil at *P*, then it is clear from the foregoing, that this lead pencil will reproduce in a smaller scale any figure or drawing, the contours of which we follow with the tracer at *T*, the proportion of the reduction being dependent on the proportion between *C F* and *D F*. If for instance we make *C F* = 2 *D F* then the reproduction will be half the size of the original.

Again if we interchange the position of the tracer and the pencil, fixing the first at *P* and the latter at *T*, then it is clear, that the pencil will reproduce in a *larger* scale any figure or drawing, the contours of which we follow with the tracer at *P*, the proportion of the enlargement again being dependent on the proportion between *C F* and *D F*. If as before we make *C F* = 2*D F* then the reproduction will be twice the size of the original.

Such are the general principles underlying the construction of all pantographs. The details can be and actually are varied in manifold ways. In all the various constructions, however, the condition must be fulfilled of the three cardinal points, the fulcrum, the tracer and the pencil always being situated on a straight line; this being the case the rate of reduction or enlargement will depend on the proportion the distance between tracer and fulcrum bears to the distance between pencil and fulcrum, a proportion which as we have seen remains constant for the same rate of reduction or enlargement and which can be expressed by a proportion between lengths which remain unaltered by turning the parallelogram around *F*, in our case the lengths *C F* and *D F*.

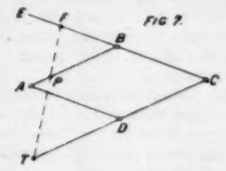
In order to allow the instrument to be set to any desired rate of reduction or enlargement *F* must therefore be made to slide on the arm *F C*, and the latter should bear a graduation by means of which we can set *F* so as to make *D F* any desired fractional part of *C F*. Besides this *P* must be made to slide on the arm *A D* and the latter should bear a graduation by means of which we can set *P* so as to stand in a straight line with *T* and *F* after the latter has been set to the desired figure of reduction. In the case under discussion at present therefore, two of the cardinal points must be movable in order to change the *rate* of the instrument; there are, however, other constructions with only one of the cardinal points movable, as we shall see further on.

The theory being given there only remains a few words of advice upon the practical working of the pantograph; and for this purpose Fig. 7 is used, showing in a diagram form a very serviceable pantograph supplied by KEUFFEL & ESSER, instrument makers of this city, for reproduction work at a comparatively low price. Of course, more perfect and complete pantographs are made for especial use, but the cost is correspondingly greater.

Referring to Fig. 7, the sides *F B* and *A B* are graduated, each graduation line being marked with its corresponding figure of reduction. The brass mountings carrying the fulcrum and the pencil,

*Prepared by Mr. E. A. Giessler, with Messrs. Keuffel & Esser.

slide on the arms *F C* and *A B* and are furnished with perforations having a mark on the circumference which is set to coincide with such of the graduation lines on *F C* and *A B* as represent the desired reduction. The brass mounting carrying the tracer is constructed similarly, but its mark is always set to the only one graduation line which the side *T C* carries. The steel joint bolt at *T* is notched, and the weight holding *T* in position is provided with a screw fitting into such notch. The way of attaching pencil and tracer is easily understood at sight



without further description. Besides resting on tracer and fulcrum the instrument is further supported by a roller at *C* and one at *E*, so as to make its movements easy and steady.

The pencil should not be clamped by means of the set screw, but should be allowed to rest on the paper through its own weight, and if not sufficiently heavy the small circular lead weights, furnished with each instrument, should be attached to the top by fastening the little wooden rod into the hollow brass cylinder of the pencil holder and sliding the weights over it. The brass mounting for the pencil cannot be slid off without taking the instrument apart, an operation which should never be indulged in; the brass mountings for *F* and *T*, however, can easily be slid off, and if this has been done, care must be taken to replace them correctly, always remembering that the position of fulcrum and tracer is on the inside of the arms *F C* and *C T* respectively, so that both *face each other*; if one or both are put on the outside, then the instrument will not work right. The correctness of the position of the three cardinal points, when the instrument has been set to a certain reduction, can easily be tested by holding a straightedge alongside of them; when they are found to stand on one straight line they are correct.

In order to set the instrument for example to a reduction of one-quarter, *T* is set to its constant mark, *P* is set to the mark one-quarter on the side *A B*, and *F* is set to the mark one-quarter on the side *F C*; then the weight, lead pencil and tracer are put into position and the height carefully regulated by means of the set screws, so that the instrument stands horizontal, when it is ready for work. When carefully handled this instrument will render very good work.

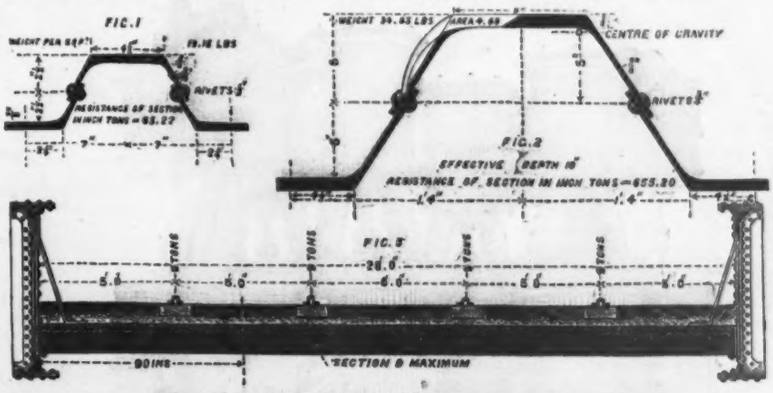
A NEW DREDGE.—One of the most curiously devised vessels that has ever been constructed at this port is the steam pumping dredge *Reliance*, which has left for New York, where it will be used in the removal of Gedney's Shoals and other dangerous obstructions to New York harbor. The *Reliance* is 164 ft. long, 36 ft. beam and 14 ft. depth of hold, with a displacement of 1,500 tons, and is provided with two 300 H. P. compound engines and two boilers with three furnaces each. The deck and hold are literally filled with engines, the pumping machinery alone weighing 207 tons. There are two centrifugal pumps of 18 ins. diameter with a pumping capacity of 44,000 galls. besides two powerful pumping engines each of 150 indicated H. P., but which can be made to exert a force equal to 225 H.P. each. The hold is filled with various kinds of engines and for numerous purposes. The machinery is all aft, and the forward part of the vessel is divided into bins, into which the dredged material is carried by suction. At each side of the vessel are large pipes, 65 ft. long and 16 ins. in diameter, which, when in use, are plunged into the sea. A test of the pumps was made before the vessel sailed by extending the vertical arms of the pipes toward a group of workmen on a wharf, and in less than a minute hammers, chisels and other tools were carried to the bins in the vessel's hold by the tremendous suction of the pumps, where they mingled with the hats, coats and other loose stuff on the wharf.—Philadelphia *Record*.

Lindsay's Steel Flooring.

The following illustrations show a type of steel flooring as made by W. H. LINDSAY & Co., of England, and illustrated in *The Engineer*.

Fig. 1 shows sections of the forms used in small bridges, piling and ordinary floors in buildings. In Fig. 2 the effective depth of the section is increased to such an extent that it may be used for heavy loads, or a double line of railway without intermediate girders, as shown in Fig. 3. Fig. 4 and 5 show the application of these sections to the construction of fireproof columns, and without this protection they may be used as columns, either with or without filling pieces. Fig. 6 illustrates some of the forms of fireproof floor construction into which these shapes enter.

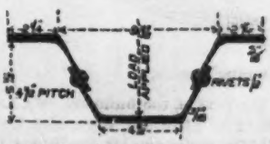
The strength of the decking is very well shown by the experiments recorded as follows: The experiments were made for the Great Northern Railway Co. by Mr. HENRY SADLER, who states:—"I have



Figs. 1, 2, 3.—Light and Heavy Sections and their application.

loaded the piece of decking that you sent me, and the result exceeded my expectations. I was not, however, able to break it, as I could not get a sufficient load put on it. I enclose you an account of the experiments. Experiment No. 1, on a single trough; a min. section, weighing 16 lbs. per ft.; span 10-ft., and the load applied in center of span on bottom flange in the direction indicated by arrow:—

Load applied.		Deflected.
9	tons	$\frac{3}{4}$ in.
10½	"	$\frac{7}{8}$ in.
12	"	1 in.
15	"	bent downward without fracture.



The load of dead weight applied on the bottom of the center trough on an area of 2 ft. at center of the central trough.

Load.		Deflection at *A. A.*	Deflection at *B. B.*
4½	tons	$\frac{1}{16}$ in.	Nil.
8½	"	$\frac{1}{4}$ in.	Nil.
11½	"	$\frac{3}{8}$ in.	$\frac{1}{16}$ in.
13½	"	$\frac{1}{2}$ in.	$\frac{1}{8}$ in.
15½	"	1½ in.	—

It will thus be seen that one trough, unaided by the support of its fellows, and only weighing 16 lbs.

Figs. 4 and 5—Fireproof Columns.

per ft., took the astonishing load of 15 tons applied in the center to cripple it.

The sections have been designed so as to obtain the greatest strength the system of construction will allow, and their actual strength has been found by experiment. The moment of resistance, in inch tons, is appended to each section, so that users may determine the particular trough required for any case. The effective area brought into action is graphically shown on maximum section, Fig. 2, by the white curved space at the left-hand side of the section, which in this case, for the complete section, is equal to 9.36 sq. ins. Mr. LINDSAY calculates the necessary section as follows:—"The effective depth being 10 ins., making the safe working strain 7 tons per sq. in., the moment of resistance of the section = area by depth by 7 tons = $A \times D \times 7 = 9.36 \times 10 \times 7 = 655.20$ in.-tons; the sectional strength thus obtained is shown to each section of maximum and minimum strengths, with which information it becomes a simple calculation to decide on the proper section.

"The new steel section *D* maximum, Fig. 2, has a weight per square foot of area covered of only 34.83 lbs., and by an increased depth to 12 ins. its sectional resistance is raised to 655.20 in-tons. It has been specially designed to carry a double line of railway between two main girders, the strength being computed as follows:—The weight of the wheels of the locomotive may be taken to spread over 2½ sections. The amount of resistance = 655.20

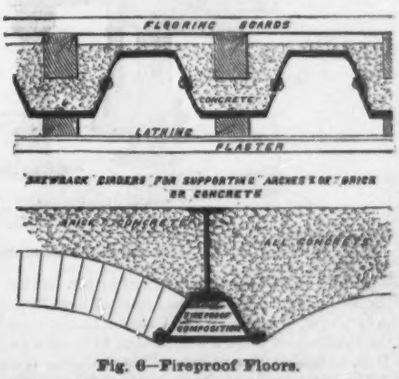


Fig. 6—Fireproof Floors.

$\times 2\frac{1}{2} = 1638$ in.-tons. The length from bearing on main girders to center of gravity of the two driving-wheels of the engine is 90 in. $\therefore \frac{1638}{90} = 18.20$ tons. This section is recommended for bridges over railways and roads of 30 ft. and 35 ft. span without the use of main girders, a light parapet of corrugated or plate iron being all that would be necessary to form a good and substantial bridge."

A DOUBTING THOMAS writing from Paris, says there will be no 1,000 ft. Eiffel tower to grace the Champ de Mars at the Exposition next year, for the reason that workmen cannot be found who will crawl about among the members beyond the 250-ft. point of altitude. This is probably a newspaper correspondent's idea of such work. But if there is any real difficulty about securing Frenchmen, the contractors have only to send for a few of the trained workmen who have just carried the towers of the Forth bridge to a height of 326 ft.; or, if they must go farther afield, any of our American bridge erectors will furnish a gang which would crawl to the moon, if only provided with a few angle-bars and rods to travel upon.

A New Type of Pumping Engine.

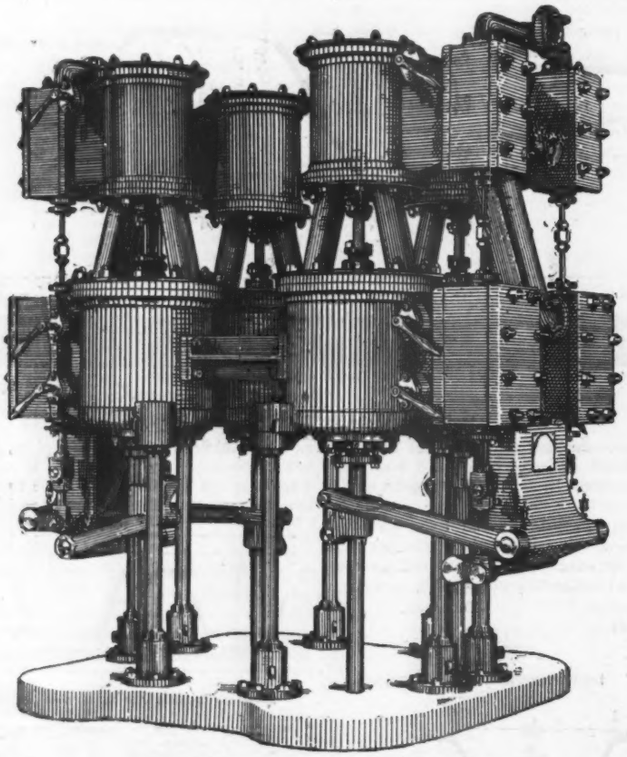
We illustrate a new form of pumping engine as built for Champaign, Ill., by the Gordon & Maxwell Co., of Hamilton, O., from the specifications of CHAS. H. LEDLIE, Civil Engineer. It is a vertical compound duplex direct double-acting pump, with outside packed plungers. It was put to work in January, 1886, and has been run continuously with but trifling repairs since. The capacity is somewhat over 500,000 galls. per day each; the piston speed is from 100 to 120 ft. per minute; the steam cylinders are 18 in. diameter for the low pressure, 12 in. for the high pressure, and the pump cylinder is 7 in. in diameter. The stroke is 12 in. and the distance from the bottom of low pressure cylinder to the top of the pump, or water cylinder is 48.6 ft. It is claimed that these are the first engines of this type built in this country.

The circumstances which led to the adoption of this form of engine are thus detailed by Mr. LEDLIE: When he was appointed engineer of the Union Water Supply Co., of Champaign and Urbana, Ill., he found at the first named town a shaft about 80 ft. deep and 7×14 ft. in lateral dimensions. This shaft was lined with heavy timbers and divided into three compartments, and from it the town authorities proposed to obtain their water supply, this water standing within 42 ft. of the top. Under these conditions horizontal pumps could not be well adapted to the case owing to the trouble of getting at them and the danger of syphoning the water from the boilers. Mr. LEDLIE having seen a small high pressure duplex pump under test, and for certain reasons set upright while working under this test, concluded that a pump of this type set vertically, would meet his needs. So he consulted with Mr. THOMAS J. WHITMAN, of St. Louis, and receiving his approval of his first sketches, he prepared an elaborate set of specifications, and upon these the Gordon & Maxwell Co. constructed the engines as shown.

In setting this pump, two large blocks of concrete were first set on each side of the shaft and on these two brick pillars, 8 ft. square and about 6 ft. high, carried iron bed-plates anchored to the masonry. Three I-beams resting on this brickwork supported the iron bed-plate shown under the pump. About 18 ft. below this, another plate was put in the shaft, with columns between; then another set of columns and plate, and finally the pumps were bolted to the bottom flanges of the lower columns, leaving the entire arrangement suspended from the I-beams. The pumps and rods were lined up, and side bracing put in from the shaft and suction and discharge pipes attached.

To avoid the weight of such long solid piston rods, these were made of extra thick 3½ in. pipe smoothly finished where they passed through the guides in the plates and connected by 6 in. couplings. The pumps were double acting, and of the usual type excepting that they were set vertically. The same may be said of the steam end of the engine.

The test was only a capacity test. Steam was furnished from two horizontal tubular boilers, 60 in. diameter and 18 ft. long. These boilers evaporated 5 lbs. of water to 1 lb. of Illinois coal. The steam test pressure was 85 lbs., the piston speed was from 100 to 110 ft. per minute, and the engines worked very smoothly, showing most excellent work on the part of the builders. Mr. LEDLIE believes that by substituting this engine for one of a horizontal type under similar conditions, the experience of two years shows that there is easier and less repairs required and a saving of about 40 per cent. in steam, and hence coal, by avoiding the conveying of this steam through 50 ft. of pipe to the pump. The proper preparations of the shaft for a horizontal engine would also have represented another very considerable item of expense, here saved.



A Vertical Compound Duplex Pumping Engine.

The Water-Works of Kansas City.

BY G. W. PEARSONS, CHF. ENG. NATIONAL W. W. CO.

Continued from page 346.

The Troy Valve.—The use of variable and occasionally high speed, makes the water valve action important, several valves have been tried and condemned. The valve now made by the Holly Manufacturing Company, and known as the Troy valve, from having been first used there, has proved more reliable than any other yet tried here. It is shown in Fig. 4. The seat used here is leather, with soft rubber backing; the valves to Pearson's low service pumps are loose discs of soft rubber on brass gratings.

The Kaw Point works are auxiliary to the first plant, but include the supply of the combined cities of Kansas City, Kan., Wyandotte, Armstrong and Armourdale, lying about 1 mile nearer the center of these cities than the present Wyandotte works, which will be discontinued, but kept in reserve. This plant, supplying these cities and the bottom lands in Kansas City, relieves the first plant, and enables it to use all its capacity for the high service. The present engine is a Worthington duplex, compound condensing; steam cylinders, 25 and 43⅛ in., plungers 26 in., all 4 ft. stroke; jet condenser. This, like the Gaskill, is too well known to need description here. It is supplied by a battery of four 200 horse power Heine safety boilers, set with United States rocking grate bars for burning bituminous slack. At all the works, 25% of boiler power is kept for cleaning and repairs.

These works, being centrally located, are more ornate in buildings than either of the others, and have room for duplicating the present machinery. The engravings being from photographs, render further description unnecessary.

Change in Source of Water Supply.—The first works were placed so far up the Kansas river that they were considered safe from any city contamination for many years. Already, however, the city has grown beyond them, and the company have had to guard against pollution from various sources.

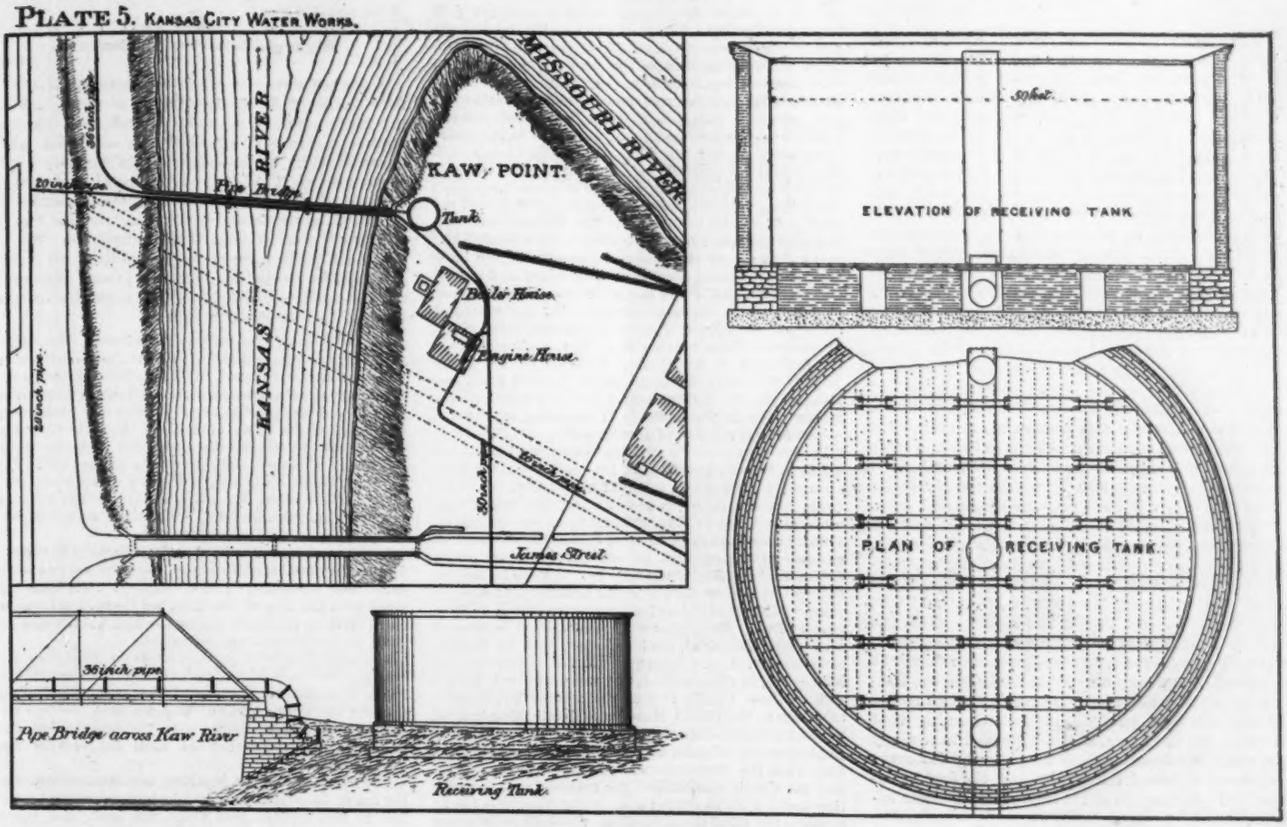
The unexpected growth of the cities requiring additional supply, and public opinion being so strong against the continued use of the Kansas river water, the studies for change showed it as practicable to reach the Missouri river as to go as far up the Kansas river as would be necessary. The great bend in the Missouri river, and the constant shifting of its channel, makes it a very difficult stream to reach for permanent location of intake. At the point marked (4) on the map, for some unknown reason, the shore line has been almost stationary since 1826, the earliest record. At the railroad bridge the deepest rock surface is 50 ft. below low water. The stratification, alternate beds of limestone and clay shale, being nearly horizontal, seemed favorable for tunneling, and studies were made to place the low service works west of Harlem to supply high service works, at the north end of the bridge, by gravity through the projected tunnel. The cost of works at this locality being, by estimate, much less than at the point chosen, and the works more central. A commission of engineers from New York, however, on inspection chose the site east of Quindaro, considering the tunnel project uncertain, and the shore line less secure than when the United States had fortified it with mattress and rip-rap.

At the site chosen the shore is guarded by this mattress work, extending from the top of the banks to nearly the full depth of the channel, being about 150 ft. wide, and reaching a depth of about 15 ft. at low water. The work is done with unusual thoroughness, and probably renders the shore line as stationary as it can be made.

(TO BE CONTINUED.)

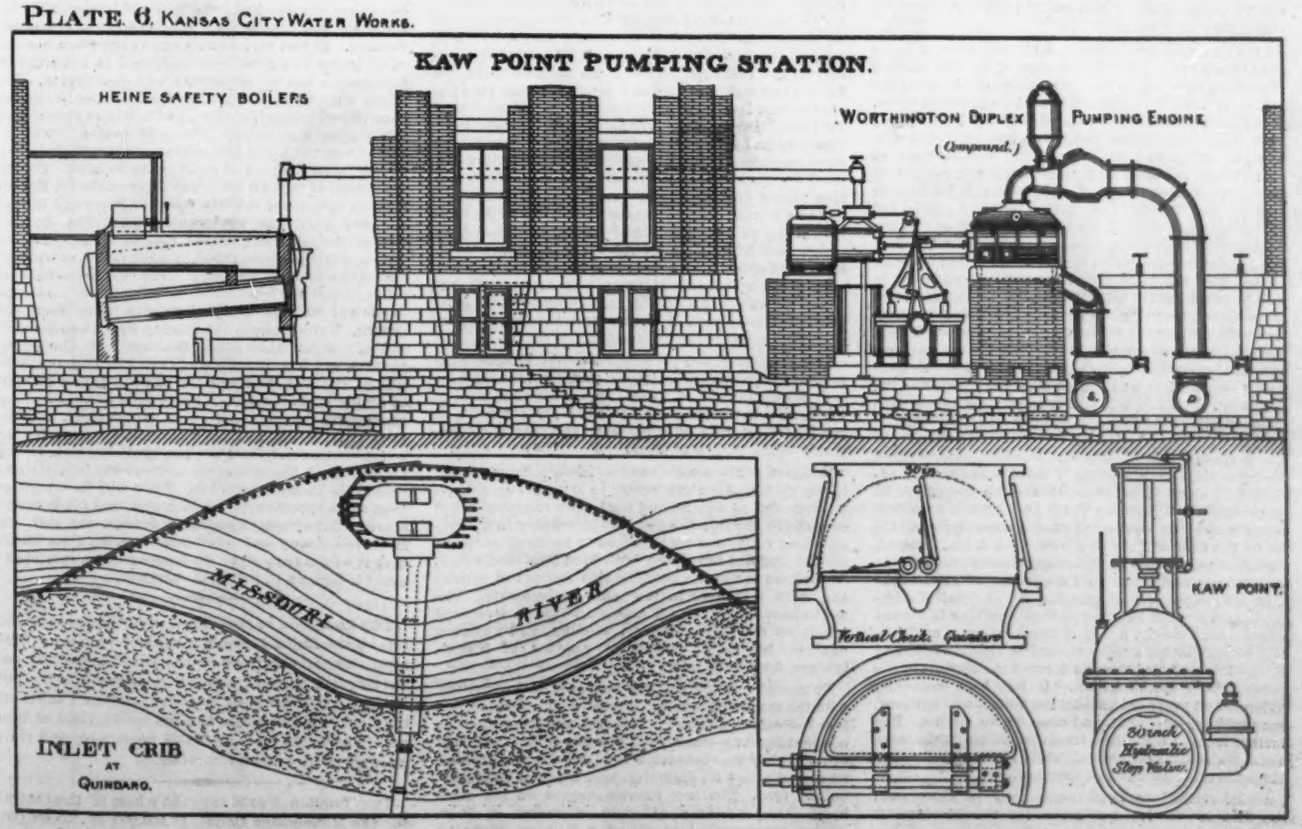
CONCERNING American trading prosperity the *St. James' Gazette* says:—"We are apt in this country to ascribe the marvellous progress of the United States somewhat too exclusively to the opening up of new land, forgetting that even the oldest part of the country—the New England States—is far from having attained the stationary condition at which we seem to have arrived here in England. Perhaps no single test of progress is more trustworthy than the railway earnings; and, according to 'Poor's Manual,' in the 7 years from 1879 to 1886, while the mileage of the New England lines has only increased about 9 per cent., the receipts have amounted from $40,000,000 to $62,000,000, an advance of over 50 per cent. And, strange though it may seem, tried by this test, New England has actually advanced more rapidly than the States of the Pacific slope. These latter have also increased their traffic receipts 50 per cent.; but to earn this they have increased their mileage from under 4,500 to over 7,600. But the part of the country which has made the greatest progress of all is neither the east nor the west, but the States of the south. There the 13,000 miles of rail of 1879 have grown to 18,000 in 1886, while the receipts show an improvement of more than 80 per cent. Even in her commerce America is apparently democratic, and does not suffer King Wheat to reign as undisputed sovereign."

PLATE 5. KANSAS CITY WATER WORKS.



Kansas City Water Works: Kaw Point Station.

PLATE 6. KANSAS CITY WATER WORKS.



Kansas City Water Works: Kaw Point Station.

The Locomotive Record of the Stephenson Works.

The great historic firm of ROBERT STEPHENSON & Co., Limited, of Newcastle-upon-Tyne, have recently republished from the *Royal Album of Arts and Industries* the sheet reproduced herewith showing graphically, as that firm only can show from its own records, the growth of the locomotive from its first conception in 1825 to the present day. There is nothing so especially new in the record, except in its completeness and convenience, but in this respect alone it is worthy of reproduction, and it is also interesting in another way as showing the rapid Americanization of the English type of locomotive, which has been going on for many years in spite of English conservatism, and, we may fairly say, prejudice, and never faster than now. We may add that we have still another reason for reprinting the sketch of the works, to again correct the ungenerous and unworthy misrepresentation, printed in italics below, as to the origin of the "bogie," or truck, which Messrs. ROBERT STEPHENSON & Co. should well know by this time to be incorrect, as it has been repeatedly shown to be in this and other journals, both English and American, and as it doubtless might be shown to be from the records of their own works, if their correspondence and order files still exist, as we understand we do. We should hardly take the trouble to correct this error again, if the question were merely England versus America, but the great engineer who really designed the first "bogie" engine, Mr. JOHN B. JERVIS, and who sent the order and design to England, which the Messrs. STEPHENSON merely built, is entitled individually to this credit, and this great firm should be ashamed to represent otherwise. They and the English people in general have honorable enough record in the arts and sciences without claiming that which is not their own, as has happened in so many prominent instances besides this, like the discovery of anæsthetics and telegraphy, and the first invention and construction of the high-pressure steam engine.

We have commented more fully on the illustrated locomotive record, and on this last matter on the editorial page. The more interesting part of the sketch of the works which accompanies the illustrations are as follows:

Like all great inventions, the railway system had a small beginning, and the tramways of the last century (contrived to facilitate the conveyance of coal from the collieries to the seashore) had but little practical value. It is the object of the present article to trace the history of the firm and business where the greatest of civilizing agencies originated, and where the manufacture of locomotives has been since uninterruptedly carried on for a period of 64 years. The Stockton & Darlington Railway was the first line opened, and by a special Act of Parliament, applied for at the instance of GEORGE STEPHENSON in 1823 the company was empowered to work the railway by locomotive engines. While the building of this line was in progress, STEPHENSON continued to devote considerable attention to the improvement of locomotives, the future importance of which in connection with railway enterprise he clearly foresaw. In 1825 the railway above mentioned was formally opened; but the employment of locomotives on this line was generally regarded as little more than an interesting experiment. Down to this time all the locomotives constructed after STEPHENSON'S designs had been made by ordinary mechanics working at the various collieries in the north of England. He had, however, long realized that the accuracy and style of their workmanship admitted of great improvement; and he therefore, in conjunction with EDWARD PEASE and THOMAS RICHARDSON, founded the celebrated engine works now carried on by the firm of ROBERT STEPHENSON & Co., Limited. STEPHENSON'S object in founding these works was to concentrate under one roof a number of good workmen for the purpose of carrying out in detail the improvements which he was constantly making in his engines. Accordingly, a commencement was made in 1823 by purchasing a piece of land in Forth street, and the building erected thereon formed the nucleus of the present huge establishment. It has been gradually extended on every side, absorbing houses and gardens, foundries, glass-works, and even whole streets. The factory forms a somewhat irregular figure, and covers about eight acres of ground, while the original works extended altogether to less than one acre.

Actual operations were commenced in June, 1823; the first locomotive was made for the Stockton & Darlington Railway, and is still to be seen at the railway station in Darlington, where it is mounted on a pedestal. As evidence of the small scale upon which the factory was originally worked, it is worth mentioning that the first fortnightly pay amounted to only £12. 2s. 2d., while now thousands of pounds are paid away fortnightly as wages. Owing to the hostile opposition manifested against the introduction of locomotives, the working during the first few years proved very discouraging. It was not until after the return of ROBERT STEPHENSON from South America whither he had gone to superintend some important mining operations, that the works may be said to have become successful. In 1829 the Directors of the Liverpool & Manchester Railway offered a prize of £500 for the best locomotive which should conform to certain specified conditions, and the elder STEPHENSON designed the famous *Rocket* for the contest. The Rainhill competition, and the marked superiority which it established of the *Rocket* over its three rivals resulted. The locomotive in question combined many novel and important features, and it says much for the scientific principles upon which it was constructed that in the main it embodied the principal features characteristic of the locomotives of the present day. The inauguration of the Liverpool & Manchester Railway, for which the *Rocket* had been constructed, made the first great impression on the national mind that a revolution was taking place in the methods of traveling, and in the means for conveyance of merchandise. An important fillip was thus given to railway enterprise, and at the works of Messrs. STEPHENSON locomotive engines were soon after turned out in rapid succession. Foreign countries, too, soon ranked among the firm's customers, and Messrs. STEPHENSON in those early days, even as they have done in more recent times, supplied engines to Continental as well as American lines. Seeing that the *Rocket* ushered in a new era in railway enterprise, it is worth recording that for a number of years it did regular service on the Liverpool & Manchester line. When afterwards superseded by heavier and more powerful engines, also built by Messrs. STEPHENSON, it was bought by Mr. J. THOMPSON, of Kirkhouse, in Cumberland, and was employed upon a colliery line. Finally it was presented by Mr. THOMPSON'S son to the Patent Museum at South Kensington, where its contemplation cannot fail on the one hand to impress every beholder with the thought of what might have been the consequences to mankind if the *Rocket* had not clearly established the feasibility of locomotive traction on railways; and on the other it helps to recall to the mind the marvellous revolutions in every direction for which we are indebted to the STEPHENSON family.

In 1833 the first bogie engine was designed and constructed at these works, this locomotive having been built for the Saratoga & Schenectady Railroad in America, and its design has been since extensively and successfully adopted wherever a railway route is intersected by sharp curves; the principle of the bogie in shortening the fixed wheel base producing a much steadier running engine than is otherwise obtainable. In course of time the locomotive was gradually improved by certain modifications and the addition of various parts, among the most important being the application of the "link motion" for working the slide valves; this was the invention of one of STEPHENSON'S pupils named WILLIAMS, and was worked out by WILLIAM HOWE, one of the foremen at the works. The improvement has since been universally adopted in all classes of engines, both at home and abroad. It is indeed a noteworthy fact that a great and well-deserved prestige has always attached to the Newcastle Engine Works; and many of the most celebrated engineers of Europe and America have acquired here their practical training.

The stationary engine constructed by GEORGE STEPHENSON in 1823 is still driving a portion of the machinery; the engine has, of course, been renewed in most of its details, but some of the original parts remain in good working order after the wear and tear of considerably more than sixty years.

In 1830 11 engines were built by Messrs. STEPHENSON; in 1840 that number was raised to 44; in 1860 to 67 locomotives and 15 marine and stationary engines. Since then the production has gone on increasing in a corresponding ratio, and no less than 79 locomotive and 11 marine engines have been built here in a single year, in addition to which a considerable amount of repairing work was done in the same twelvemonth. The works have turned out altogether 3,630 locomotives, and nearly 400 marine, stationary, winding, and pumping engines, besides a very large number of boilers, bridges, dock-gates, etc.

By way of contrast and for purposes of comparison with the mammoth engine, shown for the London and South-Western Railway it is worth recalling that the original *Rocket* locomotive of GEORGE STEPHENSON had cylinders of 8-in. diameter, a 17-in. stroke, and driving-wheels of 4 ft. 8-in. diameter, and weighed altogether but 4¼ tons. The new express engine on the other hand, has cylinders of 18-in. diameter, a 24-in. stroke, four-coupled wheels of 6 ft. 7 in. diameter, and a four-wheeled bogie. The six-wheeled tender attached to the engine carries 2,800 galls. of water and 3½ tons of coal. The total length of engine and tender is 52 ft., and their aggregate weight, when in working order, about 78 tons!

Strange Behavior of Cement.

In the last report of the Government engineer officer in charge of the Ice Harbor at the mouth of the Muskingum river, Ohio, we find the following strange instance of extraordinary and long postponed swelling of cement, which is certainly "important if true." We have never heard of any other instance of such behavior in the brand mentioned, or indeed in any other, although something like it on a much smaller scale is not infrequent. We do not vouch for the correctness of the diagnosis given, and shall be pleased to give space to any contradictory evidence, but the matter is of so much scientific interest that we give it in full.

The Ice Harbor at mouth of Muskingum river, Ohio, was begun in 1880, and at the present time is little more than one-half completed. The approved project is the construction of a large lock through the first, or lower dam of the Muskingum river slack-water system, by means of which boats navigating the Ohio river can have access to the Muskingum pool at times when there may be danger from ice floods in the Ohio. The new lock is also designed for the use of all boats passing to and from the Muskingum river, as the old lock is in bad condition, and may at any time become impassable.

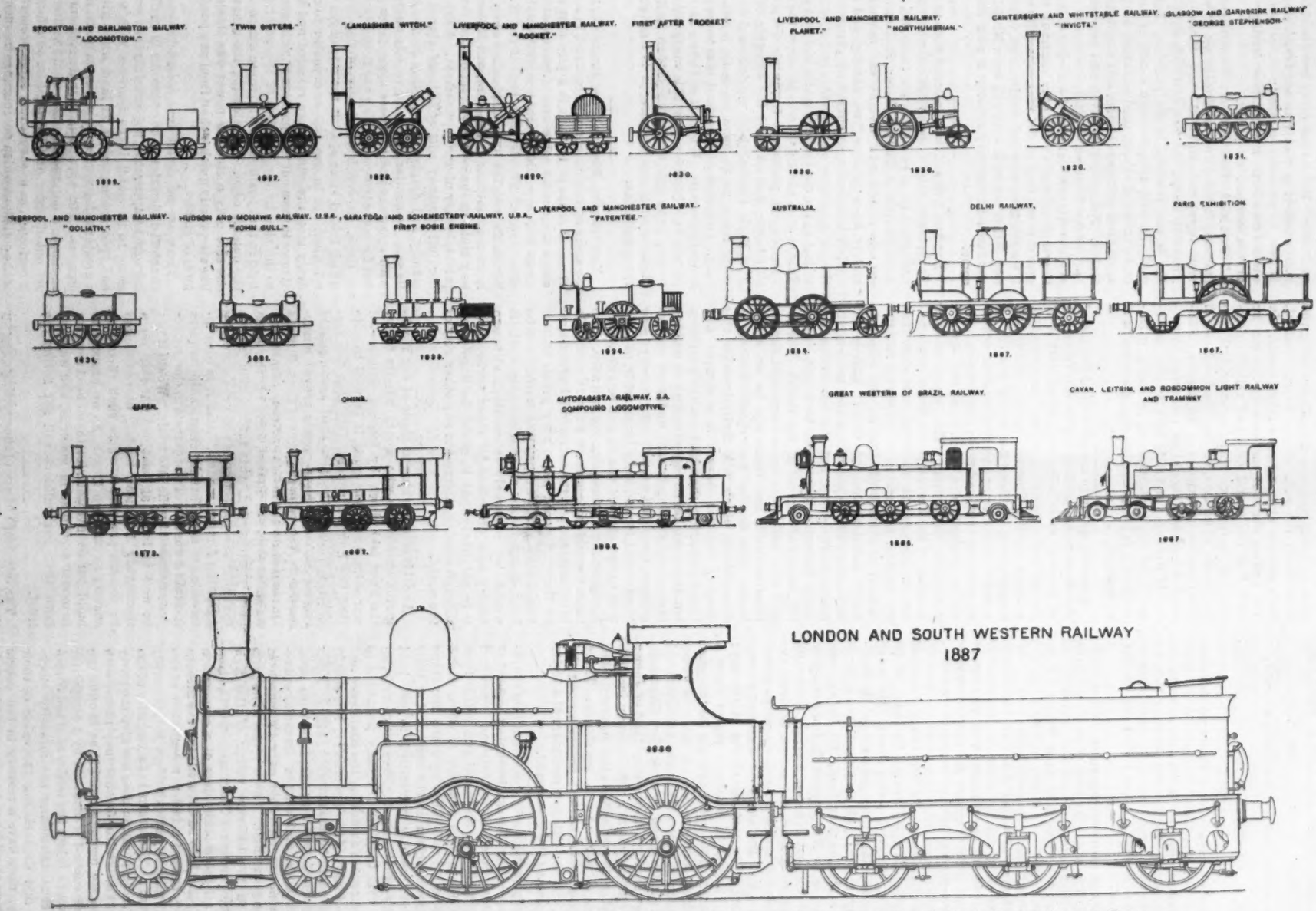
As the work now stands, the new lock walls have been built to full height, or nearly so, from the upper end to 30 ft. below the center of lock chamber. This takes the walls past the line of the dam, but there yet remains some 220 ft. of the lower end of the lock upon which no work of construction has been done.

The work thus far built is in excellent condition, except the part built in 1881, in which Buffalo cement was used. The samples of cement furnished by the Buffalo Cement Co. were excellent, and the first few lots received from them came up to the sample, but the quality steadily deteriorated until the cement was finally rejected.

The shortness of the working season, however, and the hurry in which work had to be done, caused some lots to be accepted that would not have been taken under other circumstances. It was believed, however, that the cement would ultimately harden, and that the surplus of strength in the walls would justify the use of weak cement in an emergency. Such would probably have been the case had not a new and irremediable defect soon manifested itself—the cement kept steadily *swelling*. At first very minute cracks appeared in some of the joints, but these were supposed to be mere surface cracks due to expansion and contraction. The joints were opened out and repaired with Wampum (American Portland) cement, and it was supposed that the matter was ended. The next season it was observed that the joints had opened again, and that some of the lower courses of stone were bulging. During the season of 1883, no work was done on the Ice Harbor lock, on account of the failure of the River and Harbor Bill, and work was not resumed until 1884. By this time all the joints of the land wall, as far as built, had opened and the removal and reconstruction of the wall was unavoidable. As there were no indications of failure below the level of the upper mitre-sill only the portion of wall above this level was taken down and rebuilt. Unfortunately the remedy was not sufficiently radical; leaks have since developed in the lower courses, which were allowed to remain, and the junction of the new wall with the old one is now marked by a wide vertical crack. If the cement would ever stop expanding, the damages could be repaired, and the work could be put in good condition, but thus far the action continues. The two piers above the lock, for the protection of the gates when open, are in a state of ruin from internal swelling. They will be rebuilt as soon as an opportunity can be found, and funds can be spared. Notwithstanding these defects, the lock can be made a strong and serviceable one, but I am afraid that it will always show disfiguring leaks, that ought never to be seen in well built masonry.

THE first train to cross the Arctic Circle passed the line on the Lulea Railway a week or two ago. This most northerly railroad in the world runs up from the Swedish port of Lulea, at the head of the Gulf of Bothnia, into Swedish Lapland, within 4 miles of the Gellivera Mountain, famous for its yield of iron ore. The works were begun 27 years ago, and then were given up until quite recently.

THE London *World* says the whole of the capital for the Manchester Canal, £7,000,000, or $35,000,000, is now subscribed and operations will soon commence; 1891 is the date set for completion.



The Development of the Locomotive Engine, 1825—1867, at the Works of Robert Stephenson & Co., Limited, Newcastle-upon-Tyne.

ENGINEERING NEWS

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WE are indebted to Mr. EDWARD A. EVANS, of the Pontiac Pacific Junction Railway, for an interesting series of charts showing the mean monthly and annual temperatures of the Hudson Bay region and Eastern Canada, for a period extending from Sept. 1881, to Oct. 1885, as observed by Mr. ANDREW R. GORDON. The conditions about Hudson Bay, as shown by the isothermal lines, are not particularly encouraging for navigation and extensive development. The isotherms for January show—20° to 25° (Fahr.) on the shores of the bay; and in August, the southern shores show a temperature of 50° as a maximum for the year. The average temperature for the year under observation is about 18° in the neighborhood of York Factory, and 14° near Fort Churchill. At Moose Factory, at the south end of James Bay, the average is 25°. The average in Hudson Strait is 15°, with 25° as the January minimum and 40° as the August maximum. There is, unfortunately, no text accompanying the charts; but they tell their own story of a pretty cool region all the year round.

We are pleased to note some signs that the interpreters of our laws are becoming somewhat less obtuse to a sort of railroad wrecking, which differs from the usual and vulgar type in that those who practice it often stand high socially; and while they are like those of the lower class in the respect that their crimes are usually committed to get hold of other people's property, they are more fortunate in that they are generally permitted to keep their gains as well as the confidence and respect of most of the community. Nor should these offenders be too severely judged. Long use has sanctioned very many customs upon our exchanges, and among financial operators, which are tolerable only by reason of their long standing. There seems to be little reason in the extreme ruling of the New Hampshire Supreme Court requiring the consent of all the stockholders of a corporation when a lease is to be effected; but the present tendency toward a fuller recognition of the rights of minority stockholders is thoroughly gratifying. The control of a majority of the stock of a corporation does not give the party in control a right to do what they please with the corporate business; and if, as is often the case, that control is obtained by a competitor who seeks to injure the business of the corporation, thus defrauding the minority stockholders and depreciating the value of their property, they have a remedy in the courts which they should not be slow to seek. It is partly because our statutes concerning corporations are so defective that railroad financiering has come to have so doubtful a reputation, and that investors of small amounts, who hold really the bulk of the world's capital, have come to shun railroad investments. In the present state of our laws no one can be sure that the sound, safe and reliable company of to-day may not to-morrow fall into the hands of an IVES, or like the Baltimore & Ohio become the victim of its friends. Railroad securities should be the safest investments possible; and it is because this movement for the protection of minority stockholders is in this direction that we welcome it so heartily.

A RECENT report to the Geological Section of the British Association for the Advancement of Science gives some interesting details of the present condition of the experimental heading for the Channel tunnel, which the Southeastern Railway has so far backed. A hole 7 ft. in diameter and 1¼ miles long, nearly all under the sea, and made five years ago, remains perfectly dry and with the surface noticeably hardening. The much shorter heading on the French side is in the same condition. The report adds that it is clear that the original estimate of £1,527,000 for half the tunnel, or some $15,000,000 for the whole, is amply sufficient for the work. This is but little over $700,000 per mile, which is certainly marvellously cheap, but the conditions are more favorable than could be found, probably, in any other part of the world. The report goes on to ridicule the supposed danger from invasion, and there can be no doubt justly. The English may rightly hesitate to do anything which will really increase this danger, for the channel is a cheaper and better protection than half a million soldiers, but there can be no real difficulty in making the tunnel absolutely safe under all contingencies, since half a dozen different ways may be provided for suddenly blocking it, in addition to the obvious one of one or two strong fortifications commanding the entrance. The tunnel would so certainly be very profitable to its builders, and the commercial advantages to England would be so very great, that it would seem as if its construction could not be long delayed. As an engineering work it would be extremely interesting, although hardly as a precedent for other works, since it is not likely that it could be duplicated through similar material in any other part of the world.

As a bit of a warning to those of our Washington authorities who would blindly follow the lines laid down by foreign builders of war-ships and great guns, it is well to note that the English papers state that the machinery trials of the new steel armor-plated cruiser *Narcissus* have "again proved unsuccessful." Viewed in the light of Capt. BUNCE'S late report on the defects of the *Atlanta*, and its sister ship, the *Boston*, built on the same lines yet untested, this information shows that absolute perfection is not yet assured by following foreign models. And it is also interesting to note that American ship builders foretold a number of the defects in the *Atlanta* demonstrated by the late trials. Would it not be well to build at least one war-ship on a thoroughly American model, untrammelled by foreign precedents where such should be counter to our own ideas? As we propose to build our own vessels, let them be American in model as well as in material, and we have faith that our builders will not betray the trust.

THE late death of one of the erecting gang on the Poughkeepsie bridge by falling from a height of 235 ft., is only remarkable from a standpoint of height. Similar accidents will happen on all public works and are often unavoidable. But on the other hand too large a percentage of mortality among bridge erectors is due to personal carelessness, or even to sheer bravado, as any engineer familiar with bridge erection can testify.

Taken as a class there are no more sturdy, fearless, faithful and intelligent set of workmen anywhere employed than these same American bridge erectors, and their daily calling is one perilous in the extreme. But familiarity with danger seems sooner or later to cause the most experienced workman to throw aside even ordinary caution, and his life is the forfeit. No amount of advice and care on the part of the foreman in charge seems to avail against this gradual loss of all sense of fear in the employé, and we can only continue to regret this waste of useful life; especially when it results from personal carelessness, or an action called out by a desire to show his fellow-workmen how utterly reckless a man can become.

THE first fruits of the late brake-tests at New York, noted herein, were visible almost immemediately in a prompt order from the New Yerk Central & Hudson River Railroad for 500 sets of the new freight car apparatus, merely as a "starter" we assume, and in a declared intention to substitute the new for the old apparatus on passenger trains, at least as fast as the old needed repairs and renewals. This is as it should be, unless indeed the substitution on passenger trains should go on still faster, and we trust the example of the New York Central will be followed by all other lines, as we have no doubt it will ere long. In fact, we understand that some have already done so. When it is shown as completely as it has been, that it is easily possible to stop passenger trains in less than half the distance they now require, it is time something was done.

Now that the Westinghouse Brake Co. have no more worlds to conquer on land, in a mechanical sense at least, it is a pity that they could not get up some sort of marine attachment which would operate equally well to stop vessels. The terrible loss of the W. A. SCHOLTEN with 130 lives emphasizes anew the need of something of the kind, and if there is any truth in the analogy from nature, it is in principle easy of accomplishment. A fish under full headway will stop itself almost instantly, and simply by projecting its fins from its side. A similar device for vessels was tried with apparent great success some years ago, but for some reason nothing has been heard of it since. It consisted simply of flap wings which folded close against the side of the vessel when not in use, but on occasion to suddenly stop the wings were released and were at once thrown out to a position at right angles to the side by the pressure of the water, and held in that position by wire ropes attached to the outside edge. By releasing the wings on one side only a steering power was obtained, likewise, vastly quicker than from any possible form of rudder.

There are no doubt very considerable mechanical difficulties to be overcome in perfecting such an apparatus, but certainly they would seem to be small in comparison with what has been accomplished on land, while giving a greater safeguard against even more terrible dangers. The apparatus is in its elements of so simple a nature that there would be little to get out of order, and it would be so efficient, if perfected, as to save a very large proportion of the collisions which now occur so frequently, and under existing conditions must continue to occur.

The Westinghouse Brake Tests.

"Prove all things; hold fast to that which is good." The wisdom of "proving all things" was never better illustrated than in the remarkable series of tests which began at Burlington, Ia., nearly two years ago, and may fairly be said to have culminated at New York on Monday of this week, since a record was made here, which not only surpassed all earlier ones, but left no ground still to conquer, although the tests will no doubt be continued for mere exhibition purposes. The wisdom of "holding fast to that which is good," remains to be illustrated by the responsible managing officers of our railroad system, through the speedy and general introduction of this most perfect device, which it is now quite safe to say has already become the standard freight brake. If they do not do so, they most assuredly will not be held guiltless in this world, and, if we might borrow for a moment the prophetic prerogatives of another profession, they will not in the next, for in a moral sense at least, much longer neglect to introduce train brakes will come close to what the law characterizes as "acts evincing a depraved mind, regardless of human life," and punishes by a term in State's prison when it results in the death of innocent sufferers.

It now seems certain that the general introduction of freight train brakes cannot be long delayed. The times are far more ripe for it than they were for the application of passenger brakes thirteen years ago, when, as we have already noted, a sort of triumphal procession was made through the country with a passenger train, which was very speedily followed by the general adoption of the brake. A still more notable triumphal procession is now being made through the country with a 50 car brake train, and with it stops have been made in St. Paul, Chicago, Cincinnati, St. Louis, Cleveland, Buffalo, Albany, Boston, and now in New York, far surpassing anything ever before done with brakes on the face of the globe, and leaving absolutely nothing to hope for or wish for in the way of further improvements, unless it might be some cheapening of the apparatus. The necessity being so urgent for some better means of stopping freight trains, and the good qualities of the brake being now so well known from passenger experience, it can hardly be but that the effect of this latest exhibition will be more speedily visible even than was the first.

It is difficult to speak of such remarkable results as have been attained without a certain enthusiasm. It is rare indeed that a mechanical device can show itself to be not only as good as can be expected, but as good as can be desired, and a year ago it seemed hopeless that the Westinghouse or any other air brake could ever do this without the aid of electricity. The late test at Weehawken, however, in which a train moving at 22 miles per hour on a 1 per cent. down grade was stopped *in 91 feet*, leaves nothing to be accomplished, since it shows a retarding efficiency of 21.09 per cent., of the weight on the brake wheels. As the pressure on the brake-shoes was, if the figures given us were correct, only about ⅞ of the load on the braked wheels, this shows a coefficient of friction, *as an average of the whole stop*, of 24.6 per cent. According to the Galton—Westinghouse experiments, made in England in 1878, the highest coefficient at the moment of coming to rest is 25 per cent., and this very rapidly falls to 18 per cent. at 20½ miles per hour, and to 10 per cent. at about 55 miles per hour. To be sure, these latest tests were made with sand and the Galton tests without sand, but that should make no very great difference, and the coefficient obtained at least indicates that there is no known ground to conquer, if not that the quickness of stop was beyond what previous experience gave any reason to believe was even theoretically possible.

This performance, moreover, is only fractionally better than the stops which have been made at eight other cities, which have ranged from 89 to 120 ft., excluding the Albany record of 76 ft. at 19 miles per hour on a 0.6 per cent. down grade, which was the best heretofore. That figure is well calculated to impress the imagination, but it is not really quite as good a record as the New York performance, the comparative brake efficiencies figuring out 20.45 against 21.09 per cent.* In view of the undoubted fact that there is no special trick or jockeying necessary to produce these results in regular service, but that anyone can obtain them from any well cared for train fitted with the same apparatus, these results may certainly be called miraculous.

The Westinghouse Company have very wisely brought out in these tests, however, that the actual condition of the brakes on the average passenger train is very far inferior to what it might be. The enormous contrast found in the last test is shown in the record of test No. 9. in another column. At Boston it was less extreme, but even there it was 547 against 319 ft., an excess of 228 ft., stopping from a speed of 38 miles an hour; in other words the passenger train took well on toward twice as great a distance to stop in, and at New York much more. In fact, standing on the engine of the freight train, it was very curious to observe that as the brakes were simultaneously applied to both trains as they ran neck and neck at 45 miles per hour, the passenger train shot ahead of the freight from the very instant of application almost as if the latter were standing still. And yet it is quite safe to assume that these special trains of passenger cars had had their brakes inspected with more than usual care before they were sent out to the testing ground. The average passenger train, caught strictly "on the fly" from ordinary service, would be extremely likely to make a still worse showing.

What is the reason for this great contrast? It results undoubtedly from four concurrent causes all readily removable.

1st. The passenger brakes have still the older forms of triple valve and air couplings, and not the newer forms, which have just been introduced. This would account for a considerable difference, but not for any such difference as exists on such short trains as 12 passenger cars or 20 freight cars. It is a defect, however, which, now that the better apparatus exists, should be quickly remedied, since the necessary substitutions are not expensive.

2nd. The sleeping and parlor cars of the country, almost without exception, have brakes on only 8 of their 12 wheels, thus diminishing the effective retardation by more than one-third. Now that our fastest trains are so very largely composed of such cars, this is an evil which urgently demands reform, since it has undoubtedly caused many accidents, and must continue to do so. In these particular tests, however, there were only one or two parlor car on the train, so that the loss from this source also can not have been great, as it certainly would have been with the ordinary through train.

3rd. The passenger brakes of the country are, to a very large extent, geared down to very low pressures in order to save wheels, the average Master Car Builder seeming to feel a stronger impulse to make a certain saving of wheels than a possible saving of lives. There is a partial justification for this, as respects through cars, in the fact that widely different air pressures are used on different roads, so that unless a man is sure that all the pressures used will be the same, he will naturally adjust his brake-leverage not to slide the wheels under the highest pressure. The sleeping car companies are notorious and aggravated offenders in this line, their leverage giving almost invariably very low power; an evil which urgently demands reform, by legislation if it cannot be had otherwise. Flat wheels are a great nuisance undoubtedly, and if passenger brakes are geared high enough to give their full power in emergencies, *and train men are not compelled by proper discipline to use this power with moderation in ordinary stops*, they must occur much oftener than they otherwise would, but if it were understood by the general public that the average passenger train takes twice as long as it need to stop, simply from the effect of these two last mentioned causes, there would quite certainly be a burst of public indignation which would compel human life to be placed first and car-wheels afterwards.

4th. The condition of the brake apparatus is, we have no doubt, very often inferior to what it should be from lack of sufficiently vigilant maintenance. How great an evil this may be we certainly cannot undertake to say. Experience has not shown the brake apparatus to be hard or costly to maintain, and there may not be so much loss from this cause as we imagine, but we imagine it is considerable.

But whatever the causes of the enormous contrast in efficiency between the test train and the working passenger train, the contrast exists and the causes are easily remediable. It behooves our railroad companies, therefore, to promptly set about remedying them, and we have no doubt that, in part at least, they will do so. Were they to do what they might do, it is speaking well within bounds to say that the aggregate damage by passenger train collisions would be reduced fully one-half and that from freight collision be almost done away with. It is not to be expected that freight brakes will be set so as to give the very last degree of efficiency, regardless of the wheels, as passenger brakes certainly should be, but when two trains approaching each other at a united velocity of 44 miles per hour can be stopped within a distance of 406 ft., even with very easy brake pressure, there is not much left to desire, since it is rare indeed that two colliding trains can have such velocity, or approach so nearly to each other without discovering their danger.

Every one who appreciates the terrible loss of life and property which now results from accidents which the universal use of *the best* forms of brakes in *the best* condition will easily prevent, must watch with anxiety and hope for the beginning of the end which must surely come, the universal use of this invaluable safeguard on all regular trains. There has been from the first no rational hope that more than one kind of freight brake could ever come into general use. The conditions are far different from what they were with passenger trains. Passenger cars for the most part stay at home, and even sleepers run over a few lines only. Hence it is comparatively easy for one line to use one brake and one another, and it is rather remarkable that the

*The computation of the efficiencies is an exceedingly simple matter which we have heretofore explained. The "velocity-head" due to a speed of 22 miles per hour, is by the table which we have already published 17.19 ft. Then 17.19 ÷ 0.91 = 18.89 per cent. as the grade of retardation of brakes, to which add 1 per cent. actual grade and we have 19.89 per cent. as the retarding efficiency of the brakes in the whole train. But about 6 per cent. of the weight of the train, viz. the engine truck and the tender load, was without brakes. Dividing 19.89 by 0.94 +, consequently, we have 21.09 as the per cent. of efficiency on the braked weight only.

Westinghouse automatic is so nearly universal as it is. The Long Island Railroad, for example, uses to this day the old Smith vacuum brake with its accordeon-like brake cylinder and noisy exhaust, and it matters nothing to it what the rest of the world uses. It keeps along in its second-class way unconcerned. But even with that isolated road it will be far different with freight cars. It exchanges them with other lines constantly, like all the rest of the world, and it would be an intolerable nuisance to it and its connections to have a different brake from the rest of the world. The same is still more nearly true of other lines and it would therefore have been peculiarly unfortunate had any brake but the best managed to get a formidable start. It would be very hard indeed to displace such a brake once introduced, since it could not be done line by line but only by general agreement.

The Westinghouse Brake Co. have still one field to conquer, however, and we hope to see them enter and conquer it, as they undoubtedly can, if they choose. The automatic brake should be made automatic in cases of derailment as well as of break-in-two, and the first would be an even greater safeguard than the last. It was made so when first introduced, by dropping down a rod which would hit the rail if the wheels left it, but it was found in some instances that the brakes were put on by animals running under moving trains, and for that and other trifling reasons the experiment was abandoned. This, however, should no longer be, nor is it necessary that there should be that danger, since there are various other ways to accomplish the end, all resting on the fact that derailment cannot occur without disturbing beyond the normal the parallelism of truck and car-body. Mr. WESTINGHOUSE has already done so much that he owes it to himself and the country to add this last perfection to his apparatus, and we earnestly hope he will do so in the interest of good railroading and human life.

The Nicaragua Canal.

The new Nicaragua Canal expedition sails to-day under more business-like auspices than ever characterized preceding surveys; and the present party will doubtless make that careful examination and collection of controlling data which is of the utmost importance in the inauguration of a public work of such great magnitude. The weak point in this enterprise has heretofore been a certain paucity of information which has caused the widest discrepancies in estimates of ultimate cost as made by different individuals; this is now to be corrected.

But when all this detail is collected and properly recorded, the disastrous experience at Panama should warn us that the future commercial success—that is the ultimate cost of the canal compared with prospective revenue—will depend altogether upon the engineering and business skill displayed in digesting and making use of this information in the final plans adopted. The best engineering experts, men of sound and tried judgment and experience, should be called in to direct this essential part of the scheme; and the intimation that this is the intention of the present management is, we trust, well founded.

This intelligent painstaking preliminary examination of all the actual conditions and possible contingencies by the best engineers the country can furnish is the only true road to success. It means a fixed programme of action at the start, and the minimum of first cost and speedy and certain progress. The reverse of the picture is a beginning of work with incomplete surveys and the discovery, after many millions have been expended, that the promised 8 years for completion means any very indefinite time, and that the original capital must be increased six or ten-fold by delays and physical difficulties neither anticipated or provided for at the commencement. In canal-building as in all great enterprises it is the first step that counts; and the Panama shareholders are now suffering, and the scheme is apparently wrecked, by a false first step brought on by too much personal enthusiasm and faith in a previous very different work, at Suez, and too little work done upon the careful study of the task Nature had set them.

The mere physical difficulties on the Nicaragua route appear to be of far less moment than at Panama. But there are other elements introduced that must be carefully considered; and among these, are masonry locks and the safest methods of there handling great ships in transit, and the passage of these vessels through comparatively narrow channels with rock-lined sides. This last consideration would be one common to Panama and Nicaragua, and has been as yet nowhere tested on so great a scale. The Suez canal can furnish no clue as to the effect of contact with the sides of the canal under similar conditions, for that canal is in sand, and though steamers do run into the bank, with more or less frequency, no harm results other than delay to the steamer and damage to the canal section if there is an attempt to use the screw in backing out. But in a narrower channel, such as rockwork would demand for economy's sake, and with fewer long straight stretches of channel that on the Suez route, we can as yet only guess at the difficulties of keeping the ship in mid-channel, and at the results to the ship of *any* contact with the rock-lined sides of the canal. A 5000 ton ship moving at 5 miles per hour represents an amount of stored energy that it is not well to suddenly check in any way; something would have to yield under even the slightest contact, and it would not be the rock if that met the ship.

These contingencies have probably been discounted in the preliminary plans of the projectors of this last canal, or will be in the ultimate plans. But as the questions of time and cost enter into their solution, and any remedy must be to a certain degree founded on theory alone, the subject is worthy of the most careful consideration even at this stage of the game.

The Theoretical Advantages of Forced Combustion.

The progress which has been made in the last decade or two in high-duty steam pumps, and in fact steam engines generally, is well known to have been enormous, and it has now gone so far that there seems little hope for much greater progress in that direction, although of course still further progress will be made. The boiler has always been a comparatively economical device, and it is natural that there should have been less effort to improve it than to lessen the enormous gap which formerly existed between the theoretical and actual efficiency of steam pumps and steam engines. When, however, coal is burned upon such an enormous scale, and under such favorable conditions for obtaining the last degree of economy as it is in our larger waterworks, not to speak of other large stationary engines, it would seem the part of wisdom to remember that the average stationary boiler is but little more economical than a locomotive boiler, despite its great advantages of being carefully housed and lagged, of being of any size and weight desired, and of having unlimited grate-area, so as to ensure much more perfect combustion and escape from that great source of loss in the locomotive, the blowing of unconsumed coal from the stack. This last is always going on more or less, and often results in the total loss of a third or more of the fuel. It is true that under such conditions the locomotive does not show much economy of combustion, but even under its best conditions it is at such disadvantage compared with a stationary boiler in many important respects, that it seems at first sight as if it should show much less economy of combustion, instead of very little less.

That it does not do so is due simply to one cause,—that it has a forced draft, and hence does not run so great a surplus of air through the fire box, to lower the temperature of the gases, and waste so much more heat through the chimney. The loss thus resulting is peculiarly unfortunate and burdensome to waterworks, and, to the extent that it may be remedied, discreditable. We are far from asserting that it is entirely remediable, but the great room for improvement should at least be better appreciated and more considered.

It is pretty well determined that to completely consume 1 lb. of average coal requires as much oxygen as is contained in 12 lbs. of air, and with less air than this, perfect combustion is impossible, as there would not be enough oxygen to convert the carbon of the coal into its dioxide, or carbonic acid gas. Coal burnt by an insufficient supply of air has its carbon converted into monoxide only, or carbonic oxide, the heating power of which is as 4,500 heat units to 14,500 resulting from perfect combustion. The difficulty of thoroughly mixing the air with the burning fuel on the bars is so great that in everyday work with a chimney draught it is found that double the theoretical quantity of air has to be used in order to effect complete combustion, whereas with a draught forced by means of a blast pipe, as in locomotives, it is not necessary to employ more than about 18 lbs. of air per pound of coal. Here then in the two cases we find an excess of air of 50 and 100 per cent. above that theoretically called for, and the simple reason for this excess is that it is not possible to bring into contact with the burning fuel just its correct amount of oxygen, and so a larger amount is passed in, and we trust to at least half of it being utilized. Thus for every ton of coal burnt there are turned out of the chimney top 25 tons of heated gases (less the weight of the ash) of which twelve tons ought never to be there. Now we may consider that the temperature of an ordinary furnace is about 2,500° Fahr., whilst the temperature of the chimney gases is perhaps as high as 660°. This shows us that if our fuel and air had an original temperature of 60° we have added a further 2,430° and we finally throw away 660−60=600° of what we added or roughly a fourth. Of this fourth nearly half ($\frac{4}{11}$) is contained in the extra 12 lbs. of air, so that if it were practicable to avoid the use of so much extra air we should at once economize $\frac{4}{11}$ of $\frac{1}{4}=\frac{4}{100}$ of our heat, and thus save nearly an eighth of the fuel consumed; and if we could then reduce our waste gases to 300° or so, we should save a further half of the final escaping eighth and in place of throwing away a fourth of our fuel we should only waste one sixteenth of it, and where formerly we burned 15 tons we should now only burn 12 tons; for $\frac{3}{4}\times 15=11\frac{1}{4}$ and $\frac{15}{16}\times 12=11\frac{1}{4}$. This $11\frac{1}{4}$ tons is the weight really made useful in the first place out of 15 tons, and in the second place, or in an improved furnace, out of 12 tons.

Here is a possible saving from the adoption of forced draught and feed water heaters of 20 per cent. on present consumption, and though so great an economy is not practicable, we might hope for a good proportion of it

There are two reasons for the necessity of the present surplusage of air supply. One is the difficulty of proper admixture of the air and fuel at the right time, and the other is the want of a sufficiently forcible contact between them. The latter is especially obtained by the steam blast, which gives us at once a possible economy of about 6 per cent. by saving a fourth of the wasted quarter of the total furnace heat, as a result of the energy with which the particles of air impinge upon the burning fuel on the grate, forcing themselves into combining contact with it.

But an induced draught is not the best form of artificial draught, for it is caused by a rarefaction of the gases at the exhaust end of the furnace, and this tends to some extent to undo a portion of the good it has achieved. For the greatest economy, a forced draught should be by air forced in by absolute mechanical power at the feeding end of the furnace, and the resulting products of combustion should not be allowed a free escape from the exhaust or chimney end, but should be held back, so to speak, and prevented from too quickly escaping. At present at ordinary atmospheric pressures it is found that half the air supply passes off unutilized, and it would appear a rational assumption that a furnace kept throughout at a pressure of two atmospheres would by thus doubling the density of the air and furnace gases bring double the quantity of oxygen into fuel contact as compared with the ordinary draught, and so we should reasonably expect to effect perfect combustion with no very great excess over the theoretical twelve pounds of air per pound of fuel.

From this brief outline of the principles involved in the question of forced combustion, it seems clear that it is a fallacy to look for a solution by means of an induced draught, which defeats somewhat its own ends. The correct solution should certainly embody a plan for holding back the evolved gases and allowing their escape only through some equivalent for a weighted escape door. Many other points of interest are raised if we attempt to go into details on this important question, such as the possibility of utilizing the escaping furnace gas to work a blowing engine which shall supply the pressure draught. Such in effect, indeed, is the Buckett caloric engine, and an extension of the principle therein involved appears quite feasible. The field is a wide one, and is one well worth the study of both mechanical and civil engineers. Though immense difficulties surround the subject, it cannot be doubted that some more scientific method of burning fuel ought to be practiced than is now usual, in cases, like water-works, where the conditions warrant and demand precautions for the utmost economy of combustion, and in this direction rather than in further improvement of our pumping engines, lies the most hopeful prospect for further economy.

The Development of the Locomotive.

The interesting sheet of successive locomotive designs which we give in another column, extending from 1825 to 1887, or 62 years, is certainly one of which the historic firm of Robert Stephenson & Co. may well be proud and may well issue to the world, although neither that nor anything is needed to strengthen the fame of the great founder of the firm as the father of the locomotive engine. We do not indeed believe that, as is suggested in the article which we abstract, the fate of the locomotive hung on what was being done by him in 1825-30. The simultaneous activity and inventive genius, which was shown by EVANS, STEVENS, PETER COOPER, PHINEAS DAVIS, BALDWIN and many others in the United States, must make it clear to any careful reader that, poor and weak as was this country then, had the development of the locomotive not gone rapidly forward in England it would have gone rapidly forward in this country in any event. It did go rapidly forward in England, and it would be as idle as ungenerous to attempt to disparage its claim to being the true birthplace of the modern locomotive, but that the simultaneous activity here was original and not imitative is evidenced by the fact that a different type of locomotive was invented and used here almost from the first, and by the still more significant fact that the type thus originated is proving itself by the test of time to be the best, if not quite the earliest, and is now rapidly making its way throughout the world.

To this fact the page illustration elsewhere, gives curious evidence. The four most distinctive features of the American locomotive, apart from the use of steel instead of brass and copper in the fire-box and tubes, are: 1. The swivelling truck or "bogie," 2, the use of equalizing levers to distribute the load evenly on the drivers, 3, outside cylinders, and 4, horizontal cylinders. All these will be found embodied in the latest and largest design shown, as well as in several of the previous designs, and in a large and increasing number of the more modern English locomotives.

That they should have waited until this late day for introduction will be regarded by future generations of engineers, both English and American, as one of the most surprising illustrations of English conservatism. The standard English type of running gear continued for half a century to be three parallel axles, one or two of them being driving axles, with a single leading axle under the front of the engine. The very easy curves and comparatively costly and solid road-beds of the English lines (although the tracks were poor enough by modern standards) made this style of running gear possible in England, whereas it would not even have been possible in America, on the sharper curves and poorer tracks which our poverty and vast distances compelled us to use, and as respects the curves at least very fortunately, since otherwise more money might have been spent for easy curves here, as in England, than the easy curves were worth for any service. Therefore we must in candor admit that necessity was the mother of invention to a very large extent, and not superior sagacity. Nevertheless, it so happens that the particular line on which the locomotive "bogie" originated, the Mohawk & Hudson and connecting Sarotoga & Schenectady, did not have and did not need much sharper curves than were used in England. When, therefore, JOHN B. JERVIS built his first "bogie" locomotive for the first road in 1832, and ordered his second one of Robert Stephenson & Co. for the second road in 1833, he is justly entitled to the credit of doing so simply because he saw before others what was best for *all* engines and not that he was driven to it by his own immediate needs.

Within the last few years, since the "bogie" began to become common in England, an attempt has been made to claim the "bogie" as the invention of the STEPHENSONS and not of JERVIS, on the strength of this order which he sent to them in 1833. The latest and most authoritative presentation of this claim is that made by the Stephenson Co. itself, which we have given and commented on in another column, but the most amusing presentation of it was that made in the London *Engineer* of Dec. 31, 1886, which we reproduced and commented on in our issue of Feb. 26, 1887. This article was made amusing, or perhaps we might more truly say ridiculous, by the fact that in the first three lines of a short article it advanced the distinct claim that "not only the bogie but the equalizing beam or lever *can be clearly proved to be English inventions*, though an American origin is often claimed for these *useful adjuncts for rough permanent way*," and then advances a column of facts in support of this allegation *every single one of which makes directly against its claim.* The probable origin of this extraordinary blunder, we happen to know, was this: An English attaché of an American technical paper thought he had discovered that while in England, the "bogie" was invented by STEPHENSON and communicated the supposed facts to the editor of *The Engineer*, with the information that he had sent them to his paper in America. When the manuscript of his article arrived the editor of his journal observed that he had been deceived by partial facts, and entirely remodelled the article, presenting the whole facts. This remodelled article appears to have been seized upon when it arrived in England as proving what had been expected, without examination, a paraphrase was written of it, and the claim above prefixed to it without examination. Only in this way is it possible to explain such an extraordinary claim, when *the only* facts presented to support it were the following:

1829. Bogie trucks used on Granite Ry. of Massachusetts.

1830. Bogie trucks used on temporary cars on Baltimore & Ohio R. R.

1831. Bogie trucks used on passenger car, same road.

1831. John B. Jervis designed bogie locomotive for Mohawk & Hudson.

1832. Engine built and running.

1833. Second bogie engine running on Saratoga & Schenectady.

1833. "*Robert Stephenson & Co. built their first bogie engine. It was ordered Jan. 12, by Mr.* JERVIS *for the Saratoga & Schenectady. It is often asserted that this engine was the first with a bogie, but this is altogether a mistake,* AS SHOWN ABOVE." (These are *The Engineer's* own words in support of its preceding claim!)

1836. George Stephenson, in evidence before House of Lords Committee said: "*There is a contrivance I saw the other day for passing round curves, but it is by having a center to move on, so as to change the direction of the wheels to suit the curve like a gentleman's carriage*; I THOUGHT IT WOULD NOT DO." Stephenson "*says not a word about the engine built at Newcastle, although several questions were put to him about locomotives passing round curves.*"

1839. Three American bogie engines sent to England by NORRIS, of Philadelphia, for the Birmingham & Gloucester line.

1839-40. "*The bogie engine seems to have been little known to English railway men until*" these years.

1843. Bogie engine described in paper before the Institution of Civil Engineers. "*It is quite evident from the tone of these papers and the subsequent discussions that the idea was new to the most of those who took part in them,*" remarks *The Engineer* in closing this precious body of evidence (which is all it gives) to "clearly prove" the bogie truck to be "an English invention"!

A more absurd blunder was never committed, yet *The Engineer* has never had the manliness to come out and admit its blunder and withdraw its claim, and now a year after-

wards we see the firm of Robert Stephenson & Co., Limited, renewing in a formal way this utterly unfounded and indefensible claim on behalf of their firm. We trust for their own good name that they at least will never do so again.

The claim advanced by *The Engineer* on behalf of an English origin of the equalizing lever is still more absurd. It rests solely on a single patent specification for a *wagon*, of a type of which there is no evidence adduced, nor probability, that a single one was ever built. On the other hand it is well established that the equalizing lever was introduced in America in 1837-8 by Messrs. EASTWICK & HARRISON, and by 1844 was in almost universal use in America and nowhere else.

By whomsoever invented, these two devices have been indispensable to the success of the American locomotive, and it is now coming to be substantially admitted the world over, what should have been evident from the first, that they are indispensable for the greatest success of locomotives of any kind on any track. It is self-evident that no track can be perfect, and if the track were perfect the engines are not. Therefore, these devices must ever give a material advantage, first, by keeping the load evenly distributed between the truck and drivers, through the "three-legged stool" principle embodied in the truck, (which alone keeps the load on the four truck wheels always even,) and secondly, by keeping the load on each driver always even through the equalizing levers. The experiments of Baron VON WEBER made many years ago with a locomotive of the English type on very perfect track showed terrific fluctuations in the load on drivers at high speed, such as would be utterly impossible with the American type of running gear, and the mere fact that a locomotive *cannot* be used on any but the best and straightest track, is alone sufficient evidence that it cannot be really well adapted for use even on such track, since all track is bad compared with perfection, and varies only in degree. The only exception might be if there were a great difference in cost or durability, but only the most hopeless ignorance would make any such allegation in the face of the recorded facts as to the performance, first cost and cost of maintaining American engines.

As respects the outside cylinders, the case is not quite so clear. They are becoming universal, and on the whole are certainly the best, but they have one great disadvantage, that the cylinders are less perfectly protected from radiation, and the loss from this cause is, we are satisfied, much greater that is generally appreciated. Doing away with crank axles, and greater convenience of access, however, are proving more powerful arguments abroad as well as at home, and thus justifying the practice in which Americans were almost alone for several decades. The same is true of that still less important and yet typical detail, placing the cylinders horizontal, and even the American cab is making slow but steady progress abroad, although the cabs which as yet appear in England are curious looking structures to our eyes. The extraordinary doctrine is still gravely advanced in that favored land that in order to keep the "driver" awake and alert it is necessary to place him under conditions of more or less bodily discomfort. This eccentricity likewise must in time die a natural death and another detail of American practice become universal, as the use of steel for firebox and tubes certainly will in time. But the record of England as to the locomotive will be a glorious one, nevertheless, and the balance of obligation on our side. To-day it might be different, if the locomotive were still uninvented.

PERSONAL.

Mr. F. N. FINNEY, Managing Director of the Wisconsin Central R. R., has resigned.

Mr. JOSEPH C. PLATT, a director of the Lackawanna Iron & Steel Co., died recently at Scranton, Pa.

Mr. ALFRED D. OTTEWELL has been appointed Engineer of the California Bridge Co., San Francisco, Cal.

Mr. E. A. D. PARKER, of Nelson, Neb., has been elected County Surveyor for Nuckolls county.

Mr. F. L. STEVENS, of Elmira, N. Y., has been appointed Chief Engineer of the main line division of the Philadelphia & Reading R. R., with headquarters at Reading, Pa.

Mr. THEODORE THURBER, of Auburn, N. Y., the inventor of the Thurber car wheel, died at Harrisburg, Pa., Nov. 15, at the age of 66.

Mr. R. J. DUNCAN, Assistant Superintendent of the Missouri, Kansas & Texas Ry., (Missouri Pacific), at Greenville, Tex., has been appointed General Superintendent of the Fort Worth & Denver City Ry.

Mr. BRANDON MOSELY, General Manager of the Pacific Mail Steamship Co., and formerly manager of the Panama R. R., died recently at San Francisco.

Mr. JOHN BOGART, Secretary of the Am. Soc. C. E., and also State Engineer of New York, is now at New Orleans, where he is engaged as engineer of the Audubon Park.

Mr. R. ANGST has been appointed Chief Engineer of the Duluth & Iron Range Railroad, with headquarters at Two Harbors, Minn.

Mr. G. F. BIDWELL has been appointed Superintendent of the Madison division of the Chicago & Northwestern R. R., to succeed Mr. W. A. SCOTT, who has resigned. Mr. H. M. HUGHES has been appointed Superintendent of the Northern Iowa division to succeed Mr. BIDWELL, and Mr. G. E. BOYNTON is Assistant Superintendent of the same division.

Mr. EDWARD BARRINGTON has been appointed General Superintendent as well as Chief Engineer of the Pacific Railway Co. in Nebraska, and will hereafter have supervision under the direction of the president of the general business of that office, and during the absence of the president will advise the respective heads of departments on matters requiring such advice, and such other duties as the president may assign to him.

THE following is the list as published of the civil engineers who sailed to-day for work on the new Nicaragua canal surveys:—Chiefs of Parties—J. Francis Lebaron, Jacksonville, Fla.; Domingo Garcia Cartaya, City of Mexico; Frank P. Davis, Washington, D. C.; J. W. Pethard, St. Louis; Lieut. W. J. Maxwell, United States Navy; Peter Kalb, Hoboken, N. J. First Assistant Engineers or Transitmen—W. V. Alford, Garrettsville, Ohio; J. G. Holcombe, Washington; F. T. Bernhard, New York; H. C. Miller, Louisville, Ky.; P. H. Bevier, New York; MacDonough Craven, Boston. Second Assistant Engineers or Levelers—Ricardo Molina, Havana, Cuba; J. S. Ford, New York; H. C. Litchfield, Jacksonville, Fla.; Calixto Guiteras, Philadelphia; A. J. Menocal, Washington; E. W. Hunt, Wisconsin. Rodmen—Emil Diebitsch, William McCawley, and Perry Fuller, of Washington; Enrique Cole, Managua, Nicaragua; Paul Spicer, Winchester, Mass.; Paul B. Cooke and P. V. R. Van Wyck, Chainmen—Louis William Mohuan, D. D. Stratton, John M. Murphy; R. J. Wilson, Henry W. Johnson, of Washington; Daniel MacAuley, of New York. Clerks—Jacob Crowninshield, of New York, and Charles E. Kern, of Washington. There will be a number of draughtsmen and a medical staff of several experienced doctors. This corps will be divided into five surveying and locating parties, one hydrographic party and one party for making test borings. Mr. A. G. MENOCAL, Civil Engineer, U. S. N., is Chief Engineer, and Mr. R. F. PEARY, U. S. N., will be in immediate charge of the work in Nicaragua.

The Boston & New York Railroad.

The plans of the New York & Boston Rapid Transit company, the progress of whose surveys have from time to time been noted in ENGINEERING NEWS, have now been made public, and in every way confirm the favorable predictions as to the success of the enterprise which we have made ever since the success of the company in securing an entrance to New York City, and the names of the men who were at the head of the enterprise became known. The account of the work which has been done, and the manner in which the affairs of the company have been managed during the past few months, as given in the pamphlet which the company has issued to its stockholders, is of great interest both to those directly interested in the project, and generally, on account of the solid and business like way in which the company's affairs seem to have been conducted. The following are extracts:

"The New York & Boston Rapid Transit Company owns all the stock of the several railroad companies, in which are vested the franchises and property forming the continuous line from Boston to 59th street in New York City. These properties, consisting of franchises, surveys, rights of way, lands and grading, etc., cost over $150,000. All this has been paid for in cash. The capital stock of the Rapid Transit Company is $750,000 divided into 15,000 shares of a par value of $50 each.

"Not one share of the stock has been given away, not one share has been sold for less than its par value, not one dollar has been paid to any one for selling the stock, or for advertising the stock for sale. Since the organization of the Company, during which time all this property has been acquired, no salaries have been paid to any officers except to the Secretary and Treasurer, and all the expenses have been kept to the lowest possible limit. Many of the officers and large stockholders have devoted much time to the work, and have paid their own traveling expenses. These officers and large stockholders have paid for all the shares they own in cash, at par value, the same as owners who have performed no service. All interested have desired to have plain dealing. No debt has been incurred, and no money wasted. An honest endeavor has been made to build a direct line of railroad between Boston and New York, without any stock jobbing schemes attached.

"The distances between Boston and New York by the existing railway lines are: *via* Springfield, 236 miles; *via* Providence, 234 miles; *via* Willimantic and Middletown, the so-called air line, 214 miles. The numerous grade crossings of highways and railways, the drawbridges and ferries, the heavy grades and sharp curves make it impracticable to run trains over any of these lines from city to city in less than six hours.

"The route *via* Springfield has 522 highway and 8 railway crossings at grade, and 6 drawbridges. The route *via* Providence & Shore Line has 348 highway, 6 railroad grade crossings, and 9 drawbridges, in addition to the detention at New London Ferry. The New York & New England, *via* Hartford, has 306 highway, 7 railroad grade crossings, and 6 drawbridges. The direct line will have no crossings at grade, and but two drawbridges, both unimportant.

"The best engineers and railway managers in America agree that a railroad can be built between Boston and New York, on which trains can be run safely and regularly at a speed of more than sixty miles an hour. This is not a matter of opinion. They testify that they *know* it can be done. On the crooked roads over which the run is now made in six hours, the average speed, including stops, is about forty miles an hour. Scores of time-tables can be shown, issued by railroads in this country, where trains are run every day between sixty and seventy miles an hour. But this speed is made only where they have straight road and no important crossings at grade. The same time-tables show that where there are sharp curves, grade crossings, or other defects in their line, the speed is reduced to twenty or thirty miles per hour. On such a road as the Rapid Transit Company proposes to build, modern locomotives can haul trains sixty miles per hour with much less liability to accident than on the old crooked roads at forty miles per hour,

"Great improvements in railroad construction have been made within a few years. Not only is it possible to build a better road than any now operated, but it can be constructed ready for business in less than one-half the time required a few years ago. The Rapid Transit Company proposes to complete this direct line within one year from the beginning of construction.

"The Rapid Transit Company is now ready to begin the construction of the Boston & New York Railroad. The specifications by which the contracts are to be made, call for a better railroad than has yet been built in this country. It is to be a double-track road, graded for a third track. All bridges to be of stone and brick, except where they must be of iron. A solid road-bed, with 19 in. of stone ballast. No curves of more than two degrees, which for purposes of rapid transit is a straight road. No crossings at grade of highways or railroads. Steel rails 25 per cent heavier than now used on the best railroads in this country, with ties proportionally large. The road to be equipped with the best locomotives and rolling stock that modern inventors and manufacturers can supply. Such a road will be safer than any in America, and trains can be run with regularity at a speed of sixty miles per hour.

"Capitalists who desire information in regard to the financial plans of the Rapid Transit Company may address Hon. J. R. BODWELL, Hallowell, Me.; Hon.

GREGORY SMITH, St. Albans, Vt.; Gen. GEORGE STARK, Nashua, N. H'; or Hon. L. E. CHITTENDEN, 160 Broadway, New York. "Those who desire to secure contracts for construction, bridge building, building depots, shops, etc., may address D. C. LINSLEY, Managing Director, 146 Broadway, New York. "Maps of the line surveyed and located, with full details of the work that has been done can be found at the offices of the company in Boston and New York."

The report also states that favorable traffic arrangements are practically consummated with the Boston & Maine system, and that the Old Colony and some of the other New England corporations are "at least friendly" to the new enterprise. The total estimated cost is given at "less than $40,000,000," and the earnings of the road are to amount to "good interest on double that sum." One point which is not mentioned at all in the report is the great suburban traffic which the company can scarcely fail to secure at the New York end, especially if arrangements can be made with the elevated roads, or in any other manner, for a quick transfer to the lower part of the city.

The rule of "no grade crossings" is most heartily to be commended in an enterprise of this sort; and it will be almost the first road in the country constructed on this basis, and absolutely the first of any length. The $450,000 spent in preliminary work alone, together with other facts given to us, is evidence that the company has pursued a wise economy in reference to engineering work, in marked contrast to the policy of some railway promoters in other sections of the country, who are selling the work of locating their "trunk lines" to the lowest bidder.

CORRESPONDENCE.

The New Method of Dimensioning.

SAN FRANCISCO, Cal., Nov. 11, 1887.

EDITOR ENGINEERING NEWS:

In your issue of Oct. 22, Prof. CAIN informs your readers that his formula (1) is with the exception of hangers and, may be, suspenders, as universal in its application as my formula (*A*). The two formulæ are now on a basis for impartial comparison. For our western railroads, where first cost is a most important factor, and for highway bridges, the formula of Prof. CAIN gives undoubtedly excellent results, and is simple in its application, and I would like to see it much more uniformly adopted; but for our eastern roads, where the traffic and fatigue are so great I still firmly believe that formula (*A*) will give the most economical results.

A. D. OTTEWELL.

Submarine Rock Removal by Chisels.

United States Engineer Office,
PHILADELPHIA, Pa., Nov. 14, 1887.

EDITOR ENGINEERING NEWS:

You will be interested to know that the method of rock removal under water by means of heavy blows of chisel shaped cutters, described in the issue of ENGINEERING NEWS of Nov. 12, is neither a new nor a foreign invention. From 1868 to 1879 the method was employed at Rock Island rapids in the Mississippi river, and by this means a large part of the rock covering the shallow cuttings was removed. The chisels were operated in the manner of a pile driver. The shanks were of wrought-iron about one foot square, from 12 to 18 ft. long, provided with a steel chisel-shaped cutter. The shank and point weighed from 3 to 4 tons. The height of the fall was about 7 ft.

The first attempted use of the chisels in this country seem to have been made as early as 1855. In 1857 J. S. OSGOOD of Troy, N. Y., built a rock chisel excavator for work at Keokuk, Ia., and I understand that OSGOOD claims a patent on the use of such chisels. In 1871 an effort was made to apply these chisels to the removal of rock in the St. Mary's river, Mich., but was finally abandoned as unsuccessful when compared with drilling and blasting. In 1879 a comparison was made at Rock Island rapids between the cost of rock removed by drilling and blasting and by chisels. In this test the steam drilling scow removed an average of 17 cu. yds. per day and the chisel boats only 10 cu. yds. per day. The cost of the rock removed by the chisels was three times greater than that removed by the steam drilling scow. The experience had in this case indicated that the only economy of chisels obtained where the cutting was under 6-ins. in thickness and spread over large areas.

I want to congratulate you on the *liveness* of the ENGINEERING NEWS and its perfect independence in matters relating to the profession and the welfare of the public. I well remember the Chicago prototype from which was reared the present issue, and am sure that the health of the NEWS has arisen from the sturdy material with which the infant issue was endowed. Yours most sincerely,

L. Y. S.

SOCIETY PROCEEDINGS.

Engineers' Club of S. Louis.—Meeting of November 16, 1887. The regular order of the day was a communication from the board of managers of the Association of Engineering Societies. The discussion was participated in by Col. H. C. MOORE, Profs. JOHNSON and NIPHER, Messrs. ROBT. MOORE, RUSSELL, SEDDON, OCKERSON, BRYAN and R. E. MCMATH; also, on invitation by Mr. A. W. WRIGHT, of Chicago. On motion the following was adopted:

Resolved.—That in the opinion of the Engineers' Club of St. Louis an attempt at an organic union is not desirable. We, therefore, decline to favor the recommendation of the board of managers.

The following committee on nomination of officers for the coming year was then elected: J. A. SEDDON, chairman; R. E. MCMATH, S. B. RUSSELL, E. A. ENGLER, J. A. OCKERSON. Prof. JOHNSON then read a paper on "Testing the strength of Engineering Materials." His remarks were illustrated by sketches on the board; he also showed numerous test pieces of iron, steel, brick, stone and wood; also a small testing machine as used. The professor called attention to the action of members of engineering structures, first, when the stresses were applied and removed repeatedly; and, second, when in addition they were reversed. The professor applied the terms "repetition limit" and "reversal limit" to the maximum loads that could be applied under such conditions, and gave simplified formulæ for expressing same. The experimental research necessary for determining results under these conditions required great time, but he was confident that eventually data of great value would be secured. It was shown that to load a member slightly beyond its elastic limit did not necessarily injure it; in fact, to thus "take the stretch out of it" might even benefit it for some purposes. The paper was discussed by Messrs. RUSSELL, MOORE, ENGLER, SEDDON, POTTER and NIPHER, the latter exhibiting a cast iron cup which had been attached to the bottom of a piece of wrought iron pipe filled with water, and broken by firing a rifle ball from above into the water. Adjourned. W. H. BRYAN, Secretary.

The Gordon Engineers' Club of the Arkansas Industrial University, Fayetteville, Ark., consisting of 78 members, have given the following lectures recently: "Engineering as a Learned Profession," by Prof. J. B. JOHNSON, Oct. 15; "Engineering Education," by Prof. J. A. L. WADDELL, Nov. 4; "How to Become a Successful Engineer," by Prof. WADDELL, Nov. 5; "Faults in Bridge Designing," by Prof. WADDELL, Nov. 5; "Inter-Oceanic Ship Transfer Problem," by ROBT. MOORE, of St Louis, Nov. 18. LEE TREADWELL, Fayetteville, Ark., is President of the Club.

Arkansas Society of Engineers, Architects and Surveyors.—At the meeting held at Little Rock, Nov. 10, the following officers were elected. *President*: FRED. J. H. RICKON, C. E., City Engineer, Little Rock. *Vice-Presidents*: A. B. MATSON, City Engineer, Texarkana; THOS. HARDING, Architect, Little Rock; B. S. WISE, County Surveyor, Pangburn. *Corresponding Secretary*, Prof. J. M. WHITHAM, Fayetteville. *Recording Secretary*: FRANK W. GIBB, C. E., Mining Engineer, Little Rock. *Treasurer*: Major J. A. H. HANEY, Sanitary Engineer, Little Rock.

Mr MATSON, of Texarkana, read a paper on "The Aims of the Society and Legislation Necessary for the Profession," which was followed by Mr. WISE, County Surveyor, of White county, with a paper on "Legislation Necessary to Advance the Profession." Capt. H. S. TABER, U. S. Engineer, read an illustrated paper on "The Arkansas River Improvements;" Prof. WHITHAM, of the Arkansas Industrial University, followed with a paper on "Engineering Education." He traced the growth and development of technical training; called attention to the fact that an engineer must be "educated all around;" that he must be a middle man between the artisan on the one hand and the scientist on the other; that he must, to-day, be not only a mathematician and scientist, but a mechanic and draughtsman as well. He then illustrated the courses in civil and mechanical engineering offered at the University.

Mr. LEE TREADWELL, of Fayetteville, read a paper on "The Croton Aqueduct," which was handsomely illustrated by a 40-ft. profile of the entire length of the aqueduct, 33 miles, and a map of the locality 5 × 17 ft.

J. P. BATES, City Engineer of Ft. Smith read a paper on "Decimal vs. Metric System for American Engineers," the effect of which was that the Society declared itself to be in favor of the decimal system as outlined by Mr. BATES, and the committee on Legislation was requested to draft a memorial to Congress asking that it be adopted by all government engineers.

President F. J. H. RICKON read a paper on "Municipal Engineering," and Dr. J. C. BRANNER, Director of the State Geological Survey, read one on "The Methods Employed in the Geological Survey of Arkansas."

Major J. H. HANEY's article on "The Waring System of Sewerage." Mr. J. F. HOGANE's paper on "Standing of County Surveyors," and Major B. J. BARTLETT's discussion on "House Drainage and Sanitary Plumbing," were not read, but referred to the committee on publication.

Several eminent men associated with the development of the State were elected associate members. All the engineering students in the higher classes of the University and Messrs. THOMPSON and HALL, of Little Rock, were elected members of the student grade, and are allowed five years in which to advance to the active list.

Mr. BATES, of Ft. Smith, introduced a resolution which was passed, to the effect that members of the Society should give preference to the engineering students of the University when employing assistants.

President RICKON in behalf of the local committee presented Prof. WHITHAM with a gold-headed cane. He described the part taken by Prof. WHITHAM in organizing, and spoke of the success of the efforts, and the Society's prospects.

The next meeting will be held at Little Rock. At the banquet on the night of the 11th, State Governor S. P HUGHES was principal guest, and responded to the toast of the "State of Arkansas;" Mayor WHIPPLE, of Little Rock, responded to the toast of that city, and among the other 82 guests who sat down to the banquet were many gentlemen well known in States, professional and political circles. Altogether the occasion was a happy one, and we trust that the future of this youngest association will be as successful as its inaugural presages.

As a matter of course ENGINEERING NEWS was well represented at the meeting, as it is on nearly all such occasions, and we expect to keep our readers posted on the good work of this as we do of all other similar associations.

The Improvement of Tidal Rivers.

In an able series of articles on the "Improvement of Tidal Rivers," published in the *Franklin Institute Journal*, Prof. L. M. HAUPT, of the University of Pennsylvania, treats of the special application of his theories to the removal of the "5-mile bar" in the Delaware river.

This general subject is one of especial interest to the city of Philadelphia just now, and the remedy proposed by Prof. HAUPT may be briefly sketched as follows: After carefully studying and discussing the history and surrounding conditions of these obstructions and the probable causes from which they originated and by which they are yet maintained, he comments on the present systems of dykes and their deficient action in the case in hand. His theory is that the best practice would be to abandon any attempt to remove the bar entirely, but to substitute some scheme by which only a sufficient amount of material would be removed from the crest of the bar to afford a passage for vessels.

He suggests two ways of doing this. The first would consist of a series of wings or gates which swing about a horizontal axis at or near the surface of the water. These gates can be hinged to caissons, scows or any suitable floats which can be anchored at any angle to the current. To test this plan, actual experiments were made on 5-mile bar in July of this year. Two wings were put in position; the left one 140 ft. long and containing 7 gates; the right one 100 ft. long, with 5 gates, and leaving a channel way between them of 135 ft. The axes of the wings made an angle of 135° (that is an intersection angle of 45°) for the purpose of increasing the ebb prism through the channel. The gates were 12 ft. in depth and so suspended that at low water the bottom edge was about 8 ft. below the surface.

Each gate was loaded with 1,600 lbs. of ballast and the supports for the horizontal axes were 3 piles with horizontal and diagonal cross bracing to carry the bearings. These were used as more economical than floats. These deflectors scoured out a depth about equal to the distance from half-tide to their lower edge; and increased the original depth from 9 ft. to 18 and 20 ft. This work was practically done in a very few tides. Just what the ultimate effect may be, time alone can determine, though the experiment confirmed the supposition that such a floating plant would make an excellent current dredge.

The second, or permanent, device suggested is what is called a reaction dike. It is a permanent structure of such form as "to catch, compress, deflect and train" a sufficiently large prism of the ebb to give the required depth by producing a reaction of the mid-stream velocities upon the bottom.

The Westinghouse Brake Tests.

The remarkable series of tests which the Westinghouse Company has been making throughout the country with its train of 50 empty freight cars may be fairly said to have culminated in the tests, on Monday last, on the West Shore near Weehawken, as we have shown more fully on another page. The tests were nine in all, all made on a 1 per cent. down grade, and all made with the same train as was used at Burlington and in all the many stops since. Engineer CLOSE handled the engine and train, as he has done from the very beginning of the first series of Burlington brake tests, during all the innumerable official and unofficial tests which have been made since. His practiced skill no doubt has helped greatly to show the best the brake can do, although there is no apparent reason why any man of proper experience to handle a passenger train should not be able to do as well. Some 300 railroad men and engineers witnessed the tests, which were under the charge of Mr. W. W. CARD, Secretary, and Mr. H. H. WESTINGHOUSE, General agent of the Westinghouse Air Brake Co. The train was equipped with the Westinghouse trussed iron brake-beam, which deflects only ¼ in. under a pull of 25,000 lbs., but the brake shoes were not close set, but appeared to be in ordinary working condition, some of the shoes close up and others hanging far away from the wheels when released. No electrical apparatus whatever is used in any part of the train.

The great improvement which has been made in the brake as respects quickness of application, was marvellously well shown in the third test, applying brakes while standing still. Standing with a stop-watch at the rear of this enormous train, more than one-third of a mile long, in the hopes of timing an interval of a second or two between the sound of the whistle which signaled the application of the brakes on the engine and the sound of the brakes going on at the rear, it was impossible even to recognize interval enough to press the button of the watch. The sound of the whistle and of the application of the brakes on *all* the cars, from the first to the fiftieth, arrived simultaneously, so far as the ear could detect. How immense the improvement is will be recognized better by recalling that in the first series of tests the brakes had barely begun to apply on the middle (25th) car when the stop ended, or say 12 to 14 seconds, and they did no more than barely take up the slack of the shoes on any of the cars behind, so that it was found to make no difference in the quickness of stop whether the rear 25 cars had brakes on or not.

The practical effect of this in eliminating the terrific shocks which formerly occurred at the rear of the train (but not at all at the head, which made them all the more dangerous) was marvellously illustrated in the fourth and other stops. The rear two cars were packed full of passengers, and had such shocks occurred as in the former tests, a number of that careless crowd would have been killed and nearly all have been sprained or bruised. Only by the most careful preparation of the body, when warned by telegraphic signal from the engine, could such dangers be averted. In these tests there was no such warning, nor was there need of any. The shock was barely what would have been called a "half-inch" shock by the slidometer gauge, 12.in. shocks being the limit of comfort, and *twelve feet* shocks the common thing at first, being far worse than in an ordinary collision, where the breakages ahead ease the rear. The efficiency of course must rise with this quickness of application, and it has been still further increased by changes in the triple valve which admit air more quickly to the brake cylinders. The net result is visible in the following extraordinary record, which, as we show more fully elsewhere includes by much the quickest stop ever made in the world, leaving absolutely nothing to be still further accomplished in that way.

The tests were made with a train of fifty empty freight cars, each car 38 ft. 4 ins. long; capacity, 60,000 lbs.; total weight of train about 1,000 net tons, all of it braked except the engine truck: total length of train, 1,967 ft. The tests were as follows:

1st Test. Emergency stop, train running 20 miles an hour.

2nd Test. Emergency stop, train running 40 miles an hour.

3rd Test. Applying brakes while train is standing still, to show quickness of application.

4th Test. Emergency stop, with passengers aboard, speed 40 miles per hour.

5th Test. Service stop and time of release. Train stopped and started again as quickly as brakes can be released.

6th Test. Hand brake stop at 20 miles an hour with five brakemen at their posts.

7th Test. Breaking train in two.

All the above stops were made with the braking power so low (about 53 per cent. of the load on wheels) that it would not slide the wheels of empty cars in regular service.

The 8th and 9th stops were made with a train of twenty cars, to represent the ordinary passenger train, with the purpose of showing the shortest distance in which a train can be stopped in an emergency, regardless of sliding wheels. The brake power was increased to equal that usually employed on passenger trains, and somewhat above it, or about 83 per cent. of load on wheels.

RECORD OF WESTINGHOUSE FREIGHT BRAKE TESTS, WEST SHORE R. R., NOV. 21, 1887.

Test, No.	Kind of Stop.	Speed, m. p. h.	Distance, ft.	Time, secs.	Per cent., efficien'y.
1	20 m. emergency	23	203	12½	10.57
2	40 " "	41	674	20	10.15
4	40 " "	41	672	20	10.17
6	20 " hand br.	21	2153	84	1.78
8	20 " pass. emr'y	22	91	6	21.09
9	40 " " (frt.)	45	496	13½	16.46
"	" " (pass.)	"	1204	—	7.39

Test 3 was quickness of application, train standing still. Brakes went on rear car simultaneously with arrival of sound of whistle from the engine, indicating application of brakes.

Test 5 was a service stop to show quickness of release. Brakes were off after stop in 3 to 6 seconds.

Test 7 was a break-in-two at 25 miles per hour. The two halves of the train were separated 45 ft. at end of stop.

The 9th test was made with a 20 freight car train on one track, and a 12 passenger car train on the other track, both trains being as nearly as may be of the same weight and length, and both trains running neck and neck to the stopping post. Had the brakes been equally efficient, as they should have been, both trains should have stopped in the same distance.

Estimates for 1888, Department of Public Works of New York.

Gen. JOHN NEWTON, Commissioner of Public Works, sends in the above estimate of amounts required for conducting his department in the coming year:

ESTIMATES—DEPARTMENT OF PUBLIC WORKS.

Showing the Final Estimate for 1887; the Final Estimate with Transfers for 1887; the Departmental Estimate for 1888

TITLES OF APPROPRIATIONS.	Final Estimates, 1887.	Final Estimates, with Transfers, 1887.	Departmental Estimates, 1888.
Aqueduct—Repairs, Maintenance and Strengthening	$226,500	$226,500 00	$222,833.33
Aqueduct—Repairs, Maintenance and Strengthening—Salaries	23,500	23,500.00	27,166.67
Boring Examinations for Grading and Sewer Contracts	4,000	4,000.00	4,000.00
Boulevards, Roads and Avenues, Maintenance of	100,000	100,000.00	194,000.00
Boulevards, Roads and Avenues, Maintenance of—Salaries	.....	.....	3,960.00
Bronx River Works—Maintenance and Repairs	21,100	21,100.00	24,350.00
Bronx River Works—Maintenance and Repairs—Salaries	3 900	3,900.10	3,900.00
Contingencies—Department of Public Works	4 000	5,250.00	4,000.00
Flagging Sidewalks and Fencing Vacant Lots, etc.	3,000	3,000.00	5,000.00
For Brown-stone Building, Additions to	49,575	75 00	.....
For Repairs to Seventh Regiment Armory Building	3,000	3,000.00	.....
For Repairing Water-main Leading to North Brother Island	3,000	3 000.00	24,000.00
Free Floating Baths	30.000	30,000.00	50,308.00
Free Floating Baths—Salaries	20 000	20 000.00	25 151.00
Lamps and Gas and Electric Lighting	732,000	732,000.00	708,607.00
Lamps and Gas and Electric Lighting—Salaries	5,800	5,800.00	6,500.00
Laying Croton Pipes	186,000	186,000.00	231,508.33
Laying Croton Pipes—Salaries	14,000	14,000.00	18,491.67
Public Buildings—Construction and Repairs	101,000	110,500.00	166,000.00
Public Drinking-hydrants	2,500	2 500.00	7,170.00
Public Drinking-hydrants—Salaries	1,000	1,000.00	1,300.00
Removing Obstructions in Streets and Avenues	6,884	6 884.00	25,000.00
Removing Obstructions in Streets and Avenues—Salaries	3,116	3 116.00	7,500.00
Repairing and Renewal of Pipes, Stop-cocks, etc.	200,000	200,000.00	223,400.00
Repairing and Renewal of Pipes, Stop-cocks, etc.—Salaries	50,000	50,000.00	56,250.00
Repairs and Renewal of Pavements and Regrading	238,000	238,000 00	400,000.00
Repairs and Renewal of Pavements and Regrading—Salaries	12,000	12,000.00	18,000 00
Repaving Streets and Avenues	287,000	327,379.06	482,000.00
Repaving Streets and Avenues—Salaries	13,000	13,000 00	18,000.00
Roads, Streets and Avenues, Unpaved—Maintenance and Sprinkling	25,000	25,000.00	32,000 00
Salaries—Department of Public Works	100,000	108,000.00	110,000.00
Sewers—Repairing and Cleaning	141,500	141,500.00	190,000.00
Sewers—Repairing and Cleaning—Salaries	8,500	8,500.00	10,000.00
Sewerage System—Salaries	12,500	12,500 00	17,400.00
Street Improvements—For Surveying, Monumenting, etc	3,000	3,000.00	3,000.00
Supplies for and Cleaning Public Offices	110,000	110,000.00	120,000.00
Supplies for and Cleaning Public Offices—Salaries	20,000	20,000.00	20,000.00
Supplying Water to Shipping and for Building Purposes—Salaries	9,000	9,000.00	9,900.00
Surveys, Maps, etc., for Street Openings—Salaries	9,000	9,000.00	6,300.00
Water Supply for the Twenty-fourth Ward	11,670	11,670.00	7,800.00
Water Supply for the Twenty-fourth Ward—Salaries	1,000	1,000.00	1,200.00
Wells and Pumps—Repairing and Cleaning	250	250.00	250.00
Totals	$2,794,295	$2,804,924.06	$3,454,796.00

The report gives the following reasons for any material increase in the items above as compared with the estimate for 1887:

The estimate for the maintenance of boulevards and roads includes an item of $15,000 for sprinkling them, but the bulk of this excess of $94,000 over the previous year is demanded by the fact that these roads have suffered since 1883 for lack of material for filling voids and replacing the wear and tear of travel. Commissioner NEWTON says the estimate of 6 cts. per sq. yd. for the yearly maintenance of the macadamized streets represents only the yearly wear and tear after the street has been placed in good order, but does not include the sum required to bring it to a proper standard.

The increase in the item for repairing and renewing pipes, stop-cocks, etc., is due to increased work made necessary by the extraordinary amount of new streets, sewers and buildings being added; to the replacing of corroded mains and fixtures on the water front, and to the increased meter service, as there will probably be 17,000 meters in service at the end of this year instead of 14,582 as in December, 1886.

The extra $200,000 for repaving streets is none too large an increase in view of their present bad condition. The Commissioner recommends the entire relaying of many of these streets, by contract, from curb to curb as more satisfactory than patch-work. He says that present contract prices are very reasonable and advantageous to the city.

The entire rebuilding of 3,250 lin. ft. of old and dilapidated sewers is contemplated. The report also notes that Mr. RUDOLPH HERING, "who has a national reputation as a civil engineer," has been employed as consulting engineer on sewerage with the object of having the whole sewerage system of the city examined, its defects pointed out and modifications recommended, in order to make it as efficient as possible with due regard to economy.

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

CONTINUED FROM PAGE 354.

Eufaula, Ala.—The works will be completed in a few weeks; they were designed by A. H. HOWLAND, and W. F. ELLIS was Constructing Engineer. The contract for the construction of the works was taken by A. H. HOWLAND and associates. The stand-pipe is 70 ft. high. The franchise is for 30

years, and the price per hydrant, $50. The franchise is owned by the Eufaula Water Co.; President, S. H. DENT; Secretary and Treasurer, E. B. YOUNG; Superintendent, R. H. WALKER. The present population is estimated at 5,000.

Montgomery, Ala.—During the year about 5 miles extension has been added to the original system. The works were designed by A. H. HOWLAND, and W. F. ELLIS was Constructing Engineer; the contractors were A. H. HOWLAND and associates. The franchise is for 20 years, and the price per hydrant $55. The franchise is owned by the Capital City Water Co.; President, J. W. DIMMICK; Superintendent, W. F. ELLIS, Jr. The present population is estimated at 35,000.

Ann Arbor, Mich.—The works were commenced in 1885 and completed in 1886; they were designed by CHAS. E. GREENE, who also acted as Constructing Engineer. The reservoir is 175 ft. above the city. The franchise is for 20 years, and the price per hydrant is $45 for the first 100, and $40 beyond that number. The supply is drawn from springs and pumped to the reservoir. There are 20 miles of pipe, 105 hydrants, 800 taps and 2 meters; the mains are of cast-iron and the services galvanized iron. The pressure is 70 lbs. The cost was $215,000; debt, $150,000; rate of interest, 6 per cent.; the public revenue is $4,775 and the private revenue is stated to be satisfactory. The franchise is owned by the Ann Arbor Water Co.; President and Superintendent, ALEX. W. HAMILTON; Secretary, C. E. HISCOCK. The present population is estimated at 10,000.

TO BE CONTINUED.

Report on the WaterWorks at Dover, N. H.

Mr. PERCY M. BLAKE, Civil Engineer, of Hyde Park, Mass., has submitted to the Mayor of Dover, N. H., his report on the sources of water supply available for the city and the cost of the several plans for water-works shown by investigation to be practicable.

As regards the present water supply it is stated that a considerable portion of the city on the east side of the river is supplied with water from springs in Page's meadow by the Dover Landing Aqueduct Co., organized in 1826. This company supplies water for fire purposes to 4 public reservoirs, has about 200 consumers and collects an annual income of about $2,000. There are about 3 miles of street mains but no fire hydrants. All the water from this source passes at one point through a 6-in. pipe, at which point the maximum delivery under full head is 280 galls. per min. The well is 69.4 ft. above the street level at the City Hall. The Cocheco Aqueduct Association, organized in 1832, supplies the remaining portion of the city on the east side of the river from springs, with a supplementary supply from Willand pond. The well is about 100 ft. above the street level at the City Hall. The company has 13.125 miles of pipe, including 1, 1¼, 2, 3, 4, 6 and 8-in. cast-iron pipe, 6-in. wrought-iron, cement lined, and 2, 3 and 4-in. wooden log lines; there are 63 gates, 2-in. to 8-in.; 12 public reservoirs are supplied without charge. The company has about 600 consumers, and collects an annual income of about $11,000. The Dover Aqueduct Co. furnishes a supply from springs to the part of the city on the west side of the river, with a supplementary supply from Barbadoes pond which can be increased when necessary by a pumping engine with a capacity of 90 galls. per minute. The main well is about 66 ft. above the street level at the City Hall. All the water passes through two pipes 4 and 6 ins. diameter, with a maximum aggregate delivery of 250 galls. per minute. There are about 8 miles of street mains, 2 small distributing reservoirs and 4 public reservoirs, no fire hydrants. The company has about 400 consumers and an annual income of about $4,000. In addition to the water supply for fire purposes furnished by these companies there is a reservoir of about 200,000 galls. capacity, about 92 ft. above the street at the City Hall, with a 6-in. pipe; and a spring basin which supplies water by gravity, with a light head.

The present population is about 14,500. To supply water to a city of this size, with suitable pressure at all points, not less than 1,000,000 galls. per day must be provided, or 1,333,000 for a population of 20,000. An ordinary 1¼ in. fire stream, thrown from a hydrant under a static head of 200 ft., will discharge nearly 250 galls. per minute; ten such streams would, of course, require a continuous supply of 2,500 galls. per minute under the necessary pressure, and this capacity of fire streams, without the assistance of fire engines, is the least that should be provided for Dover. Seven sources of supply were considered; Bellamy river, Barbadoes pond and Kelley's springs, Cocheco river, Blackwater brook, springs in Page's meadow, springs of the Cocheco Aqueduct Association, Willand Pond. All of these are considered in the report, and the latter is recommended.

The plan proposed provides for a pumping station and receiving basin in Page's meadow, the spring water to be used for the engine. A 12-in. conduit is to be laid from the basin to the springs of the Cocheco Aqueduct Association, where a well would be constructed and carried down below the level at which surface water can infiltrate; the present connection of the Cocheco company with Willand pond can be utilized. This arrangement, which would be very economical in cost of construction, would give a supply of about 1,500,000 galls. per day. From the pumping station a 14-in. main would lead to a 16-in. rising main laid up Garrison hill to a distributing reservoir, built of earth (largely in excavation) lined with puddle, and having a concrete floor and granite block paving on the slopes. One 16-in. main would connect the reservoir with the rest of the system. The cost of construction of this plan would be $180,000.

The delivering capacity of the pipe system would be 12 fire streams simultaneously to a height of 85 ft. in the elevated part of the city, or 130 ft. at the City Hall. The work to include cast-iron street mains; stop gates and non-freezing, double nozzle, post hydrants. The annual cost of maintenance is estimated at $17,500, and the guaranteed annual income at $17,000, the deficiency being more than met by increased water rates from new consumers the first year; the guaranteed income results from the purchase of the works of the three existing companies. The system as proposed would be sufficient for a population of 25,000, and an additional supply can be obtained, when needed.

The engineer's estimate is as follows:

		lbs.
DISTRIBUTION PIPING.		
16-in.,	6,160 ft. at 130 lbs	800,800
14-in.,	1,300 ft. at 115 lbs	149,500
10-in.,	5,788 ft. at 65 lbs	376,220
8-in.,	30,024 ft. at 45 lbs	1,351,080
6-in.,	54,024 ft. at 30 lbs	1,620,720
4-in.,	9,154 ft. at 20 lbs	183,080
	106,450 ft.	4,481,400
COST OF LAYING.		
	6,160 ft. at 40 cts	$2,464.00
	1,300 ft. at 37 cts	481.00
	5,788 ft. at 30 cts	1,736.40
	30,024 ft. at 28 cts	8,406.72
	54,024 ft. at 25 cts	13,506.00
	9,154 ft. at 20 cts	1,830.80
		$28,424.92
	4,481 400 lbs. = 2,000.7 tons:	
	Say 2,020 tons, at $35	70,700.00
	85 tons of special castings, at $60	5,100.00
	205 gates and boxes	5,800.00
	125 hydrants, at $32	4,000.00
	Total cost of distribution	114,024.92
PUMPING STATION, ETC.		
	Engine house	7,000.00
	Engine and boilers	11,000.00
	Lower collecting gallery	6,000.00
	Receiving basin	9,500.00
	12-in. conduit, 3,660 ft	7,320.00
	Upper collecting gallery	6,000.00
	Valves and connections	1,200.00
RESERVOIR ON GARRISON HILL.		
	Capacity, 2,000,000 galls.	15,000.00
	Force mains	3,000.00
	Total cost	$180,044.92

CONSTRUCTION NEWS.

Water.

The Rochester Superheated Water Co. has been incorporated at Rochester, N. Y., by T. N. VAIL, Boston, Mass.; RICHARD A. ELMER, New York; MARSENUS H. BRIGGS, of Rochester, and others. The capital stock is $150,000.

The West Depere Artesian Water Supply Co. has been incorporated at West Depere, Wis., with a capital stock of $4,000. The contract for a well has been let to Gray Bros., of Milwaukee, Wis., who will commence work at once.

The Pacific Sewerage Co. has been incorporated in Colorado, with office at Denver, by A. M. JORDAN, of Atlantic City, and W. S. SNYDER and A. C. CRAMER, of Philadelphia. The company has been organized for the purpose of introducing the West system of sewerage and water filtering.

Water Waste at Toronto.—The Toronto *Globe* says that the agitation of the water question, and the adoption of a system of inspection has had the effect of reducing the waste probably 2,500,000 galls. per day. Tests made in September showed that about 6,000,000 galls. per day were running to waste, and it was then predicted by Aldermen Rogers that from 3,000,000 to 5,000,000 galls. of this amount could be prevented.

Columbia, S. C.—The Water-Works Committee has reported to the City Council in favor of the construction of an additional reservoir near the present one, at a cost of about $12,000; also for the putting in of additional pumping plant. It is desired to try the effect of these recommendations before filters are put in, but if pure water cannot thus be obtained, filters can be put in for $8,500. The report has been adopted and the committee authorized to undertake the work at once.

The Newark Intercepting Sewer.—The intercepting sewer at Newark, N. J., was formally turned over to the city on Nov. 1, by Chief Engineer SCHAEFFER, and is now under the control of the Sewer Committee. The sewer and pumping station were inspected, and speeches were made by engineers SCHAEFFER and FTELEY, among others. The sewer is 14,500 ft. long, 3 ft. diameter at one end and 6 ft. 6 ins. at the pumping station. The total cost was about $600,000.

Water Famine.—Reports from Fort Wayne, Ind., state that a water famine is imminent; owing to the long drought the water in the reservoir as well as the small streams that feed it has become so low that the elevators, in the hotels, etc., cannot be worked and the electric light company cannot obtain a sufficient supply for the boilers.——At Angus, Ia., there is an alarming scarcity of water, owing, it is said, to the mines which underlie the town having drained the water from the sand stratum above the coal.

Water Meters.—At St. Louis, Mo., parties who wanted to reduce the cost of their water supply had meters put in; they are now having them removed as they find it costs more to pay by the gallon than by the year.

Irrigation.—The Porter Ditch & Irrigation Co. has been incorporated at Denver, Col., by J. S. Porter, W. E. Tryon and others. Capital stock, $3,600.——The Mohawk Canal Co., of Yuma, Ariz., will excavate 20 miles of canal; the work to be completed in December, 1888. GEO. W. NORTON is Engineer.——The North Star Land & Canal Co., has been incorporated at Del Norte, Col., to take water from the Rio Grande, 7 miles below the city.

New Water-Works.—*Vermont.*—Woodstock. The Woodstock Aqueduct Co. has completed its works; the reservoir is 2 miles from the village, and has a capacity of 2,500,000 galls. A hydrant test resulted satisfactorily.

New Hampshire.—Dover. The water-works question will be voted on Nov. 30.

Massachusetts.—Beverly. A test of the new water supply was made Nov. 17 by the fire department.——North Easton. The works are being pushed to completion. The stand-pipe will be 104 ft. high, and 196 ft. above the village. The well will yield 1,000 galls. per minute.

Connecticut.—Windsor Locks. The Windsor Locks Water Co. will begin work in the spring. The cost of reservoir and pipe laying will be about $15,000.

New Jersey.—Kearny. Water has been turned on in the lower part of the township. The entire system will be completed by January.

Ohio.—Gallipolis. A system of water-works is wanted but the town is not willing to pay a large amount.

Virginia.—Portsmouth. The Portsmouth & Suffolk Water Co. will complete its works at once.

Kentucky.—Central City. Water-works are contemplated. Address the Central Coal & Iron Co.

South Carolina.—Columbia. A new reservoir will be built, and a new pump with a daily capacity of 1,500,000 galls. put in.

Florida.—Sanford. The Sanford Water Co. will improve its works.——Gainesville. Water-works are contemplated.

Alabama.—Decatur. The Decatur Water Co. will hold a meeting Nov. 30 to consider the question of borrowing money to build the works. JOHN D. ROQUEMORE is President.

Michigan.—Sturgis. A system of water-works is to be established.

Illinois.—Carlyle. The City Council has not yet accepted the water-works, but is waiting for a satisfactory test.——Hillsboro. A water-works committee has been appointed and an engineer will be employed to prepare plans and superintend the construction of the proposed works.

Minnesota.—Pipestone. The city has voted 117 to 54 in favor of issuing $20,000 bonds for water-works. The contract has been let to a Dubuque firm and work will be commenced at once.

Dakota.—Salem. A system of water-works is to be established.

Idaho.—Bellevue. The water-works have been completed. The total cost was about $15,000.

Montana.—Fort Benton. Water-works are to be constructed. For particulars address the Water Commissioners.

Texas.—Terrell. The well for the water-works will soon be completed.——Gainesville. An artesian well will be put down by Bell & Myers.——Bonham. The City Council has determined upon a complete system of water-works and the officials have been inspecting the works of other cities. Action will probably be taken shortly.

Arizona.—Phœnix. The City Council has granted a franchise for water-works to J. J. Gardiner.

Philadelphia, Pa.—Director of Public Works WAGNER has asked for $1,200,000 for improvements to the Water Department for 1888. Among the items are $400,000 for the East Park reservoir, northeast section; $250,000 for the Cambria reservoir; $128,000 for a supply main on Germantown avenue, between Broad and Eighteenth streets, and $100,000 for replacing small pipes. The request was favorably recommended to the finance committee.——Water was pumped into the south basin of the East Park reservoir on Nov. 21. This is the smallest of the three basins, its capacity being 62,000,000 galls.

Rochester, Pa.—The Rochester Water Co. has been organized to establish water-works. The Council has contracted for 60 plugs at $2,750 per year, and the company is now endeavoring to get private contracts to the amount of $6,500 per year. The sites for the pumping station and reservoir have been decided upon. The total cost of the works is estimated at $130,000. The company consists of A. W. McCOY, of Rochester; JOHN M. BUCHANAN, of Beaver; H. S. MCCONNELL, of New Brighton, and ELLIS MORRISON and E. A. PHILLIPS, of New Castle.

Austin, Minn.—The contractor is getting along rapidly with the new water-works, and it is expected to have them in operation early in December. About 2 miles of main will be laid this fall, and the remaining 4 miles in the spring. The domestic supply will be drawn from 8 wells, 12 ft. diameter; there is direct connection with the river for a supply for fire purposes. The pumps are supplied by the Holly Manufacturing Co., of Lockport, N. Y., and the pipe and specials by the Dubuque Brass & Iron Works. The contract calls for a daily supply of 300,000 galls., with pressure sufficient to throw 6 streams at once to a height of 100 ft.

Allegheny, Pa.—The Water Committee has been discussing plans for improving the water supply of the city, both as to quality and quantity. Superintendent ARMSTRONG suggests that the supply be taken from the river at Nine Mile island, at a cost of about $750,000 for pumps and pipes. The whole subject has been referred to the sub-committee on machinery, together with the Superintendent and a consulting engineer to be appointed. This committee will investigate all plans proposed and report to the Water Committee. The National Filter Co. has been granted permission to erect a trial plant under the supervision of the sub-committee. The Hyatt Filter Co. is now erecting a plant at its own cost to demonstrate its utility.

Land Reclamation of Louisiana.—The State engineers have finished the work of staking out the lines for levees to protect the arable land on the right bank of the river in Plaquemines parish, from Fort Jackson to "The Jump," one of the western debouchments of the Mississippi river above the main passes. For a long time the forts were the extreme limits of population on the lower river, with the exception of the settlements of the pilots and a few hamlets inhabited by fishermen; by degrees, however, the land seems to have risen out of the water and the half fluid morasses have become solid ground. Here and there small farms have been established, protected by private embankments, and as the country has begun to fill up with population and to contribute to the productive wealth of the State, surveys have been made and contracts let for levees to protect the district.

Omaha, Neb.— The water-works system is being rapidly improved and extended to meet the requirements of a city of 100,000 inhabitants. In July of the present year the plant was sold to the American Water-Works Co., which at once commenced a series of improvements which will involve an aggregate expenditure of about $1,000,000. The present pumping plant consists of a high service and a low service engine by E. P. Allis & Co., with daily capacities of 4,000,000 and 12,000,000 galls respectively; a Gaskill engine with a capacity of 5,000,000 galls., and a Knowles engine with a capacity of 7,000,000 galls.; giving an aggregate daily capacity of 28,000,000 galls. Work has been commenced on the Florence plant, where settling basins with a capacity of 30,000,000 galls. will be constructed; the total expenditure at Florence will be about $1,000,000. These works will be about 7 miles from the city, or 12 miles from the South Omaha works, and a 36-in. main will be laid from Florence to the pipe system in Omaha. The total expenditure since the organization of the water company, has been about, $2,500,000.

Tree Planting and Irrigation in Texas.—Certain Texans are endeavoring to organize a State forestey and water-supply association. An especial purpose of this organization is the planting and irrigation of Western Texas, now a treeless, rainless, poverty-stricken region. The general rainfall is greater and the soil better adapted to agriculture in Texas than in Arizona, Kansas and Dakota, and if irrigation is feasible in these sections, the projectors think it would certainly pay in Texas. A temporary organization has been effected with Col. C. W. STYLES and Prof. GEORGE G. CURTIS, of the Agricultural and Mechanical College, as President and Secretary.

Proposals Open.

Water Works Supplies.—J. M. SMITH, Marble Falls, Tex.

Paving.—Estimated cost, $98,429. THE CITY SURVEYOR, Savannah, Ga.

Water-Works.—For Charlottetown, P. E. I. Plans and specifications at the office of M. M. TIDD, C. E., 10 Tremont street, Boston, Mass. DAVID LAIRD, Chairman, Water Commissioners, Charlottetown, Prince Edward Island. Nov. 29.

Sewers.—Vitrified, salt glazed, sewer pipe, 140 lt. of 15 in. and 560 ft. of 12 in., 5 manholes and 1 receiving basin with granite head; also 900 ft. of 12 in. pipe, 5 manholes and 1 basin. ERNEST ADAM, City Surveyor, Newark, N. J. Nov. 29.

Bridge.—Across Mammoth bayou. O. N. WILDS, Natchez, Miss. Dec. 5.

Water Pipe.—About 300 tons of cast-iron coated water pipe. HENRY FLAD, President, Board of Public Improvement, St. Louis, Mo. Dec. 5.

Water-Works Supplies.—Pipe, 8, 6 and 4-in., 2,500 ft. each; 3-in., 100 ft.; stop gates, two 8-in., five 6-in., four 4-in., and two 3-in.; 20 double-nozzle hydrants; 13 stop gate extension boxes; Ts, etc. A. F. PREVATT, Chairman, Water-Works Committee, Thomasville, Ga. Nov. 30.

Pier Work.—Building new wooden pier, with approaches, etc., in place of Pier 37, East river; repairing bulkhead at foot of Market Slip, East river; and removing existing Pier 37, East river. There will be about 7,000 cu. ft. B. M. of new crib work; large quantities of timber and iron work, piles 60 to 75 ft. long, and 3,500 cu. yds. of riprap. THE DOCK COMMISSIONERS, Pier A, North River, New York City. Dec. 5.

Bridge.—Harvard bridge, over Charles river; 23 spans of iron superstructure. Plans and specifications at the office of the City Engineer. THE COMMISSIONERS OF HARVARD BRIDGE, Mayor's Office, Boston, Mass. Dec. 10.

Water Pipe.—Cast-iron pipe; 6, 10, 12 and 30 in. diameter; total 1,800 tons of 2,240 lbs. for delivery at different dates between May and November 1888. LOUIS LESAGE, Superintendent of Water-Works, Montreal, Canada. Dec. 13.

Machine Tools.—For the construction and erection at the Navy Yard, Washington, D. C., of eleven 6-in. gun lathes and one slotter. Plans and specifications at the Bureau of Ordnance, Washington. Hon. WM. WHITNEY, Secretary of the Navy, Navy Department, Washington, D.C. January 5.——Also for sixteen 16 in. gun lathes. March 1.

Contracting.

Submarine Pipe Laying.—Messrs. Thacher & Breymann will go from Sheboygan to Janesville, Wis., where they have two river crossings to put in, one of 12-in. and one of 8-in. pipe. They will then return to Toledo, O.

Pipe, Hydrants, Etc.—The Michigan Pipe Co., of Bay City, Mich., has been awarded the contract for 4, 6 and 8-in. improved Wyckoff water pipe, hydrants valves and special castings, all placed in the ground ready for use, for the water-works at Carson City Mich. The works are to be completed by January.

Pumping Engines and Water Pipe.—At Minneapolis, Minn., on Nov. 17, the Water-Works Committee awarded the contract for two pumping engines of 15,000,000 galls. daily capacity, to Henry R. Worthington, of New York, at $129,000. The contract for 12,000 ft. of 36-in. water-pipe was at the same time awarded to Dennis Long & Co., of Louisville, Ky., at $28.40 per ton.

American Export Trade.—In the *Australasian Ironmonger* we note long lists of American goods which are highly commended; among these are saws, spades, shovels, picks, weighing machines, Rand rock drills, "the most popular drill in New Zealand, and perhaps in the other colonies," rackarock, axes, Worthington's steam pumps, mill machinery, American stoves, "always growing in popularity," tram cars, barb wire, lager beer, and innumerable other articles. There are numerous references in our Australian exchanges to the great mining records, almost equaling our own, made with the Rand Slugger drills and rackarock; in fact, we have before us a list of no less than thirty-one different parties in New South Wales, Victoria, Tasmania and Queensland, that are using these deservedly popular American drills and explosives.—*Engineering and Mining Journal.*

Street Work.—*Providence, R. I.*—The contract for granite block paving on Friendship street has been awarded to C. W. BLAKESLEE & SONS, at the following prices: taking up and removing present pavement, 25 cts. per sq. yd; earth excavation and removal, 58 cts. per cu. yd.; furnishing and laying cross-walk stone, including sand bed and joints, 50 cts. per sq. ft.; furnishing and laying granite blocks, including sand for bed, joints and covering, $2.51 per sq. yd. The granite blocks and cross-walk stone which the city has in stock may be purchased of the Board of Public Works at $1.75 per sq. yd., and 50 cts. per lin. ft. respectively.

Orange, N. J.—The contract for improving Tremont, avenue has been awarded to Robert Wright, at 99 cts. for macadam, 65 cts. for cobblestone, 34 cts. for curbing and 25 cts. for excavation.

Kansas City, Mo.—The contract for grading Independence avenue has been awarded to T. Brosnahan: embankment, 21 cts. per cu. yd.; rubble masonry, $4.25 per cu. yd.; concrete, $4 per cu. yd.; 18-in. pipe, $1; rock excavation, 80 cts. per cu. yd.

St. Louis, Mo.—Contracts have been awarded as follows: Grading, curbing, Telford pavement and cross-walks; Fruin-Bambrick Construction Co., $2,612.25, $5,872.90; J. E Perkinson, $9,463.90; J. B. O'Meara, $4,877.75; Adam Kern, $1,462.40. Grading and macadamizing; Adam Kern, $1,466.30, $2,361; A. Heman, $1,713, $2,866; J. B. O'Meara, $3,832.80.

Nelson, Neb.—The contract for grading Main street has been awarded to A. L. Rogers at 18 cts. per yd.

Bridge Contracts.—*White Plains, N. Y.*—The following proposals for a 92-ft. double span stone arch bridge, the plans and specifications for which were prepared by Mr. J. A. KIRBY, C. E., were publicly opened Nov. 14, by a committee of the Board of Supervisors of Westchester county, at White Plains, N. Y.; all the bids being for the bridge complete; Wm. F. McCabe, $14,750; Alex. Dallas, $17,850; Harrison Hunt, $16,837; Daniel Murray, $16,975; S. D. Hill & Son, $17,182; Berlin Iron Bridge Co., $19,000; John Merritt, $19,000; John Kelley, $19,250.—— The following proposals were for a wrought-iron truss bridge, 66 ft. span, with abutments, complete: Berlin Iron Bridge Co., $14,877; Wrought Iron Bridge Co., Canton, O., $15,700; Dean & Westbrook, $16,600. No decision was made; the committee will report to the Board.

Waterville, O.—The contract for the bridge over the Maumee river, to be built by Lucas and Wood counties, has been awarded to the Smith Bridge Co., of Toledo, O., at $30 per lin. ft.

Rome, Ga.—The following proposals for an iron swing bridge over the Oostanaula river, at Rome, have been received by the Board of Commissioners of Roads and Revenues of Floyd county: Decatur Iron Bridge & Construction Co., Decatur, Ala.; with rock swing pier, $20,000; with iron swing pier, $19,900. Champion Bridge Co., Wilmington, O.; with rock pier, $21,050; with iron pier, $20,000. King Iron Bridge & Manufacturing Co., Cleveland, O.: with rock pier, $22,100; with iron pier, $21,950. Morse Bridge Co., Youngstown, O.; with rock pier, $26,163; with iron pier, $25,813. Pittsburg Bridge Co., Pittsburg, Pa.; with rock pier, $24,300; with iron pier, $23,800. Penn Bridge Co., Beaver Falls, Pa.; with hand latch, stone and iron piers respectively, $20,039 and $19,750; with automatic latch, stone and iron piers respectively, $20,390 and $20,103.

Princeton, Ill.—The contract for an iron bridge, on tubular iron piers, in Arispie, has been awarded to McManis & Sons for $1,600.

St. Paul, Minn.—The County Commissioners have approved the contracts with the Wrought Iron Bridge Co., of Canton, O., and P. F. O'Halloran, for the construction of the Lake street bridge.

Dayton, Minn.—A new bridge will be built across the Crow river between the towns of Dayton and Otsego; the Commissioners of Wright county and Hennepin county will do the work jointly.

Union, Mo.—The County Commissioners have rejected all the proposals for an iron truss bridge over the Meramec river as too high. The lowest bid was from the St. Louis Bridge & Iron Co., $4,225. The contract for the abutments was awarded to Mr. Rau, of Pacific, Mo., for $5,000.

Denver, Col.—The Commissioners of Arapahoe county received the following proposals Nov. 16 for the construction of a bridge across the Platte river, to consist of 11 spans of 20 ft. each, constructed of wood with pile foundations: for the entire work; Thomas O. Brown, $1,175; R. Jackson, $1,345; W. C. Houghton, $1,359; W. E. Edom, $1,540; per lineal ft.: M. Severns, $5.68; The Bullen Bridge Co., $6.74; Insley, Shire & Tullock, $7.47; T. E. Baker, $10.63. The contract was awarded to Thomas O. Brown.

Highway Bridge.—The following proposals for a highway bridge over the Patapsco river, on the line of the Hammond's ferry road, were received Nov. 12 by WM. H. SHIPLEY, C. E., Baltimore, Md.: Smith Bridge Co., Toledo, O., $7,675; King Iron Bridge & Manufacturing Co., Cleveland, O., $7,975; Wrought Iron Bridge Co., Canton, O., $7,994; Mt. Vernon Bridge Co., Mt. Vernon, O., $6,300; Pittsburg Bridge Co., Pittsburg, Pa., $6,600, Penn Bridge Co., Beaver Falls, Pa., $8,750; H. A. Ramsey & Son, Baltimore, Md., $8,845; P. E. Lane, Chicago, Ill., $8,952; Groton Bridge Co., Groton, N. Y., $9,987; Dean & Westbrook, New York, $10,980. The contract was not awarded, the bids and strain sheets being submitted to the engineers for examination. The bridge is to be a wrought-iron Pratt truss, with single or double intersection 208 ft. 10 ins. span between pin centers, 14 panels, 29 ft. depth of truss and 18 ft. clear width. Live load, 1,000 lbs. per lin. ft. The specification says "floor-beam hangers shall be so placed that they can be readily examined at all times. When fitted with screw ends they shall be provided with check nuts. Preference will be given to hangers without screw-ends. When bent loops

The St. Johnland Contracts.—The following are the prices of the bids for work at the county farm, St. Johnland, L. I., mentioned previously on p.p. 357, 374.

Material.	James W. Birkett.	Cranford & Valentine.	John H. O'Rourke.	Edward Freel.	Ryan & McDonald.
Blue stone, 60-in	$6.00	$5.00	$6.25	$2.50	$3.75
Blue stone, 27 in	2.80	2.25	2.85	1.00	1.25
Blue stone, 24-in	2.60	2.00	2.50	.80	1.20
Blue stone, 18-in	2.00	1.50	2.05	.70	1.00
Blue stone, 12 and 8-in	1.25	.50	1.25	.30	.50
6-in. stone pipe	.80	.70	.65	.30	.50
12-in. drain pipe	1.50	1.50	1.00	.40	1.25
6-in. cast-iron "	.95	2.00	1.25	.90	1.50
3 in. cast-iron "	.70	.80	.90	.50	.80
4-in. cast-iron "	.80	1.00	1.10	.80	.95
Spruce plank	24.00	30.00	22.00	60.00	26.00
Yellow pine plank	32.00	40.00	33.00	60.00	40.00
Yellow pine sheeting	40.00	50.00	45.00	20.00	45.00
72-in. sewer	25.00	25.00	24.50	21.00	30.00
48-in. sewer	18.00	12.00	15.00	8.00	16.00
36-in. sewer	12.00	9.00	5.50	20.00	10.00
Piles	12.00	5.00	3.00	15.00	6.00
Brick masonry	12.00	8.50	9.00	15.00	10.00
12-in. pipe	1.40	1.50	1.50	2.30	1.25
9-in. pipe	.90	1.00	1.25	.60	1.00
Manhole A	40.00	100.00	40.00	20.00	50.00
Manhole D	30.00	100.00	60.00	250 00	50.00
Yellow pine timber	32.05	40.00	33 00	60.00	40.00
Spruce and other plank	24.00	30.00	22.00	40.00	20.00
Excavation per cubic yard	.20	.10	.20	.17	.23
Gate chamber	2,800.00	1,700.00	3,500.00	1,000.00	2,500.00
8 boilers	2,000.00	8,000.00	20,000.00	28,000.00	12,000.00
Total	410,786.00	366,023.00	437,215.00	357,733.00	448,090.50

are used they must fit perfectly round the pin throughout its semi-circumference." The engineers are WM. H. SHIPLEY, Superintendent of Bridges for Baltimore county, and JOHN W. BOLLMAN, Engineer for Anne Arundel county.

The Ludlow Valve Manufacturing Co., of Troy N. Y., has purchased more land, and is having the plans prepared for new buildings.

The Clayton Air Compressor Works, 43 Dey street, New York, have received an order from Anderson & Barr for two No. 4 duplex air compressors, of the latest improved pattern, to be used in sinking the caissons for the bridge over the Mississippi river at Cairo, Ill. These contractors used the Clayton compressors at the new Harlem River bridge, and were so well pleased with their working that they gave the present order to the same firm.

The Vulcan Iron Works, of Chicago, Ill., have been awarded the contract, through Messrs. GEO. S. MORISON and E. L. CORTHELL, engineers, of New York and Chicago, for all the machinery for operating a drawbridge over the Willamette river, at Portland, Ore., for the Oregon Railway & Navigation Co.

Water-Works Contracts.—*Brookfield, Mass.*—The Selectmen have awarded the contract for water-works to Mr. McBride, of Brighton. The work consists of the construction of a dam and trenching and pipe laying for 76,095 ft. There will be 1,095 ft. of 12-in. pipe, 25,000 ft. of 10-in., 35,000 ft. of 8-in., and 15,000 ft. of 6-in. It will be furnished by R. D. Wood & Co., of Philadelphia, Pa., at $33.45 per ton.

Hummelstown, Pa.—The contracts for the new works amount to about $40,000. Schaeffer, Mukel & Co., of Fleetwood, will supply the machinery at $9,000; Raymond & Campbell, of Middletown, have a contract for pipe laying, etc., at $27,000.

Jeffersonville, Ky.—Messrs S. R. Bullock & Co., of New York, have the contract for the water-works.

Tuskaloosa, Ala.—The contract for a complete system of water-works has been awarded by the city to Jeter & Boardman, of the Jeter & Boardman Water & Gas Association, Macon, Ga. Work will be commenced next month and completed by June.

Baton Rouge, La.—The city has awarded the contract for the water-works to John H. Wood, of Smedley & Wood, Dubuque, Ia. The city will take 75 hydrants at an annual rental of $4,500.

Cable Railroad.—The contracts for the iron work for the new line of the Citizens' Cable Railroad Co., St. Louis, Mo., on Easton and Prairie avenues to Kings highway, have been awarded to the Rogers Foundry Co., of Belleville, and McMurray & Judge, of St. Louis.

Court House.—All the bids for the construction of the court house, opened Nov. 15 by the County Commissioners, Lincoln, Neb., were above the amount of the bonds voted and were all rejected. The lowest was $269,763.30. The work will probably be readvertised.

Viaduct.—The Department of Public Works, Chicago, Ill., received 7 bids Nov. 12 for the construction of the Jackson street viaduct. The highest bid was from the Pittsburg Bridge Co., Pittsburg, Pa., $114,800 and the lowest was from A. Gottlieb & Co., of Chicago, $89,840. The latter was accepted.

Reservoir.—The following are the correct figures of the bids for the reservoirs at St. Paul, Minn., given on page 375; McArthur Bros., St. Paul, $97,621.45; J. D. Moran, St. Paul, $114,606.50; Fruin-Bambrick Construction Co., St. Louis, Mo., $115,525.05; J. J. Palmer, Minneapolis, Minn., $119,102.39. The contract was awarded to McArthur Bros.

Artesian Wells.—*Moorhead, Minn.*—The city has awarded to Gray Bros., of Jamestown, Dak., the contract for drilling a well 1,500 ft. deep for $7,500.

Faulkton, Dak.—A contract for an artesian well has been let to Swan & Co., who will commence work Dec. 1.

Cleburne, Tex.—A contract for sinking an artesian well has been awarded to J. O. Brown & Co., of Fort Worth.

Brass Tubing and Brass Castings.—The following proposals have been received by Louis Lesage, Superintendent of Water-Works, Montreal: 4000 lbs. of tubing: Garth & Co., 23 cts. per lb.; E. Chanteloup, 24 cts; contract awarded to Garth & Co.; 16,250 lbs. of castings, I. E. F. Guibord, 20 cts. per lb; Garth & Co., 20 cts.; Cuthbert & Sons, 20 cts.; E. Chanteloup, 25 cts.: contract awarded to I. E. F. Guibord.

Granite Blocks.—The following proposals for 300,000 paving blocks have been received by the Board of Public Works, Cambridge, Mass.: Samuel Sewall, of Everett, $47 per 1,000; John J. Horgan, of Cambridge, $49; Lanesville Granite Co., of Lanesville, $62; S. & R. J. Lombard, of Cambridge, $56; J. J. Vernon, of Lanesville, for 150,000, $47.50 per 1000. The contract was awarded to S. J. Sewall, of Everett, Mass.

Terra-Cotta Pipes and Bends.—The following proposals were opened Nov. 21, by the Committee for the Construction of the Congressional Library Building, Washington, D. C.: Wight Fireproofing Co., Chicago, Ill., $6,347.50; Trenton Terra-Cotta Co., Trenton, N. J., $7,051; G. W. Rader & Co., New York, $10,719.

Lifeboat Station.—The following proposals for the construction of a lifeboat station at Galveston, Tex., were opened Nov. 21, by I. S. KIMBALL, General Superintendent, U. S. Life Saving Service, Washington, D. C.: Wm. L. Campbell, Mobile, Ala., $9,615; Harry Devlin Galveston, Tex., $14,400; F. H. Smith, New York, $16,700; Casey & Garther, Galveston, Tex., $18,500.

City Hall.—The following proposals for the superstructure of the new city hall at Omaha, Neb., have been received by the Board of Public Works, St.: A. D. BALCOMBE, Chairman: Wm. Nevins & Co., $248,800; Edward J. Brennan & Bros., $255,975; Rice & Bassett, $261,473.82; M. T. Murphy, $264,500. The contract was awarded to Wm. Nevins & Co.

Water-Works Wanted.—The City Council of Jacksonville, Ill., has decided to advertise for proposals to furnish the city with not less than 1,000,000 galls. of water per 24 hours. The council believes that the water can be secured by sinking a number of artesian wells, as the present well furnishes about 300,000 galls. per day.

Water-Works.—The contract for the water-works at Brookfield, Mass., has been awarded to McBride & Hennesey at the following prices: excavation and filling, 45 cts. per cu. yd.; dry rubble masonry, $3.50; rubble masonry laid in mortar, $4.50; concrete in place, $7; riprap and paving, $1.50 per sq. yd.; trenching and pipe laying for 6, 8, 10 and 12-in. pipe, 18, 25, 30 and 35 cts. per ft.; rock excavation in trench, $3.50 per cu. yd. The contract for pipe and specials has been awarded to R. D. Wood & Co., of Philadelphia, at $33.45 per ton and 2½ cts. per lb. The date of the contract is Nov. 14, and work was commenced Nov. 16. Mr. A. C. MOORE, of Sturbridge, Mass., is the Engineer in Charge.

Messrs. Pennock Bros., Car Manufacturers, Minerva, O., whose works were burned in April last, were not interrupted working beyond the month of June. They have about finished rebuilding the new manufactory which has fully one-third more capacity than the old one while the general facilities are much superior. There are tracks from three railroads into the works.

RAILROADS.

East of Chicago.

Existing Roads.—*New Brunswick.*—The extension from Edmundston will be completed to Lake Temiscouata before the first of the year and the whole line, 80 miles in length, is to be finished by June 1, 1888.

Philadelphia & Reading.—Seventy-five new passenger coaches are being built for the company at Wilmington, Del.——The Receivers have decided to extend the Colebrookdale branch two miles to the iron mines at Churchville.

Chatham & Harwich.—This short line on Cape Cod was opened for business Nov. 21.

Lake Shore & Michigan Southern.—The litigation over the construction of the Mahoning & Shenango Valley road still continues.——A rumor is in circulation that the company intends to build a line from Cleveland to Youngstown, O., to parallel the Nypano. The line would be run *via* Niles, Warren and Leavittsburgh. This is generally considered to be merely a threat on the part of the Lake Shore managers which they have no serious intention of carrying into effect.

Shenango & Allegheny.—President J. T. BLAIR advertises for 100 hands to begin work at once on the extension of this road.

Fitchburg.—THOS. SHANAHAN, State Superintendent of Public Works, has received a request from the company for permission to dig a basin and build a wharf on the Erie canal at a point 30 miles west of Albany. The contemplated harbor will be 2 000 ft. long and 200 ft. wide.

Clearfield & Jefferson.—The extension to Punxsutawney, Pa., will be opened for business on Monday, Nov. 28.

New York & Massachusetts.—A suit has been brought by the company against the Poughkeepsie bridge company to compel the abandonment of the proposed eastern outlet *via* the Hartford & Connecticut Western, and an adherence to the original plan of a connection with the New York & Massachusetts. Although the Poughkeepsie bridge company has secured control of the Hartford & Connecticut Western, it is a long and difficult road compared with the direct line of the New York & Massachusetts, and it is probable that eventually the latter will be the principal eastern outlet from the bridge.

Canadian Pacific.—Vice-President VAN HORNE states that the New Short Line from Montreal to Mattawamkeag, Me., will be open for business by July 19, 1888. On the line from Harvey to Moncton, practically nothing has as yet been done.——The Springfield *Republican* is generally quite accurate in its railway gossip, but it makes quite a slip in a recent issue when it states that, "The Canadian Pacific is operated in the interests of the Boston & Maine." This oracular statement will probably be quite a surprise to Sir GEO. STEPHEN as well as to the officers of the New England corporation.

New Lisbon, East Liverpool & Southern.—This line, 15 miles in length, in southeastern Ohio, is being surveyed by both the Nypano and the Pittsburg, Marion & Chicago companies, one of which will probably receive a subsidy and build the line.

Pennsylvania.—It is rumored that the officials of this company are so disgusted with the vacillating policy with which the Jersey City officials have treated the matter of the proposed elevated road that they will take no further action in the matter but begin at once the work on the Harsimus Cove passenger station. It is reported that an entrance to Scranton is to be obtained over the tracks of the Delaware & Hudson Canal Company and that surveyors are locating a line from Scranton to Carbondale and thence eastward, it is surmised to a connection with a line to the Poughkeepsie bridge.

Flint & Pere Marquette.—The company has purchased the Port Huron & Northwestern road which has a trackage of 218 miles extending from Port Huron, Mich., to Saginaw, Sand Beach, Palms and Almonte. This makes the total mileage of the above system 579 miles. The gauge of the purchased road will be widened to standard next season.

New Projects and Surveys.—*Connecticut.*—A railroad is projected from Manchester through Glastonbury to Portland, about 15 miles.

Vincennes, Oakland City & Owensboro.—Surveyors are at work on this Indiana line.

Maine.—The town of Skowhegan proposes to raise $100,000 to build a five mile line to the Somerset road at Norridgewock.

Southern.

Existing Roads.—*Warrior Coal Fields.*—Work is progressing favorably on the line between Meridian and Narkeeta, Miss., from which point the line is graded to

the Tombigbee river at Gainesville, Ala. Contracts will probably be let at an early date for the construction of the line from Gainesville to the Kansas City, Memphis & Birmingham junction near Texas, Ala., about 70 miles.

Gulf & Ship Island.—Track has been laid this season from Cotton Plant to Pontotoc, Miss., 25 miles, and from Gulfport, near Mississippi City, to Biloxi river, 14 miles. The Union Investment Co., contractors for the division from Biloxi river to Hattiesburgh, 64 miles, has 700 hands at work. Capt. W. H. HARDY is President.

Savannah, Florida & Western.—The engineering work on the Thomasville, Tallahassee & Monticello extension is in charge of Capt. REYNOLDS, P. F. JENKINS and C. S. ROBERT.

Louisville Southern.—About five miles of track has been laid on this Kentucky road, and the work is in progress at the rate of three-quarters of a mile per day.

Augusta & Chattanooga.—W. B. LOWE & Co., contractors on this Georgia road, have stopped work and brought suit against the company for $30,000 due them.

Kansas City, Memphis & Birmingham.—The Aberdeen branch has been graded to the Tombigbee river, and tracklaying is in progress. The line is to be open for business by Dec. 15.

Tennessee Midland.—The report is in circulation that this company is backed by the East Tennessee, Virginia & Georgia, who propose to give up the lease of the Memphis & Charleston division.——The officers of the company state that unless substantial aid is given by Nashville, the line will not be constructed through that city.

Atlantic & Danville.—The contractors are said to have just put on two thousand new hands between Suffolk and Hicksford.

Ohio River.—Track has been laid this year from Guyandotte, W. Va., to within about 10 miles of Point Pleasant and is expected to reach that city by Jan. 1.

West Virginia Central & Pittsburg.—President HENRY G. DAVIS is quoted as saying that his road is to work in harmony with both the Baltimore & Ohio and Pennsylvania, and is to be extended 100 miles to Charleston, W. Va. The probabilities are that the line will be extended a much shorter distance to a connection with the Baltimore & Ohio's proposed line to Charleston.

Columbia, Newberry & Laurens.—Twenty one miles of this road is graded and the contract for the masonry, consisting of 15 piers and one abutment for an iron bridge over Broad river at Columbia S. C., has been let to C. D. Langhorne & Co., of Richmond, Va. The foundations for three of these piers are completed and the neat work begun. Contract for grading and masonry for one mile, from bridge to depot site in Columbia will be let soon and also for grading 13 miles of road near Prosperity, S. C. H. C. MOSELEY of Prosperity is President and CHAS. ELLIS, JR., of Columbia is Chief Engineer.

New Projects and Surveys.—*Pensacola & Memphis.*—Preliminary surveys have been made and right of way secured from Pensacola, Fla., to Meridian, Miss. The proposed line extends from Pensacola to Grenada, Miss., 326 miles. Capital has been secured for constructing the line from Pensacola north 70 miles, and locating surveys are to be made in December. Contracts will probably be let in January or February.

Eufaula & St. Andrew's Bay.—President W. H. REEVES, of Eufaula, Ala., has returned from a trip abroad in the interest of this enterprise, and reports that capital has been secured for the construction. The line is to be 147½ miles in length, and the company has a land grant of 400,000 acres.

St. Augustine & North Beach.—This company has been incorporated at St. Augustine, Fla., by W. J. JARVIS and others to build a 6 mile railroad.

Birmingham, Mobile & Navy Cove.—Gen. JOHN MCNULTA, S. W. ALLERTON and other Chicago capitalists, have been examining the proposed route of this road from Mobile, Ala., to Navy Cove, 35 miles.

Decatur, Chesapeake & New Orleans.—This road has been surveyed from Decatur, Ala., to Gallatin, Tenn., 150 miles, *via* Fayetteville, Shelbyville and Murfreesboro. A line has also been surveyed from Decatur to Columbus, Miss., and right of way and local aid is being secured. There will be a 600 ft. truss bridge across the Cumberland river, and one 600 ft. tunnel through Elk Ridge in Bedford county, Tenn. G. C. SANDUSKY, of Shelbyville, Tenn., is President, and JOSIAH FLOURNOY, of Decatur, is Chief Engineer.

The Northwest.

Existing Roads.—*St. Joseph & Grand Island.*—The Kansas City & Omaha line is now in operation from Fairfield to Alma, Neb., a distance of 86 miles. No other new construction will be undertaken this season.

Missouri Pacific.—Grading is completed on the line from Talmage to Crete, Neb., a distance of 55 miles. Steel will not be laid before next season.

Minneapolis & Pacific.—Track has been laid this season from Lidgerwood, Dak., to Monango on the Chicago, Milwaukee & St. Paul, a distance of 70 miles.

Jacksonville & Southeastern.—Tracklaying on the 20 mile extension fom Centralia, Ill., to Driver's station has been completed.

St. Paul & Duluth.—The cut off near Duluth, Minn., from Grassy point to Thomson, 15¾ miles, has been completed.

Minneapolis, Sault Ste. Marie & Atlantic.—A locating survey is to be made at once of the spur to Florence, Wis., a distance of 25 miles, and it is probable that the line will be built early next season.

Chicago, St. Paul & Kansas City.—Tracklaying is completed from Des Moines, Ia., across the Missouri State line, a distance of 100 miles. The 60 miles between that point and St. Joseph is expected to be completed by Dec. 15.

Minnesota & Northwestern.—The latest "extensive extension" which President STICKNEY has been reported as having in prospect is a line from Dubuque to Milwaukee, Wis.

Wabash.—It is stated that the system will be taken out of Receiver MCNULTA'S hands by next spring and placed in the hands of the purchasing committee. Gen. MCNULTA favors extensive repairs to keep the property of the company in good condition, and advises replacing all wooden bridges with iron and building next season 20 miles of new second track out of Chicago.

Red River Valley.—An injunction has been granted prohibiting the Provincial Government from building the road. Nevertheless a contract has been finally closed with Mr. HOLT by which he agrees to complete the line if the Government gives him peaceable possession.

St. Louis, Alton & Terre Haute.—On the new Chicago St. Louis & Paducah road, track has been laid from Marion, Ill., to Burnside Junction, about 15 miles. The contractor on this section was N. W. IRISH of Carlyle.

New Projects and Surveys.—*Lincoln, Red Oak & Des Moines.*—This proposed line is to extend from Lincoln, Neb., to Des Moines, Ia., a distance of about 190 miles. The projectors of the enterprise have asked aid of the city of Lincoln to the amount of $150,000 under rather novel conditions. The bonds are not to be issued until the road is actually in operation between the two cities. The company agrees never to consolidate with any other corporation operating a railroad into Lincoln, and for 30 years from the completion of the road, never to charge more than certain specified maximum rates for the transportation of freight between Lincoln and Chicago. If the company violates this contract, it must repay the bonds to the city, and must deposit with a trustee $200,000 of its own bonds as a perpetual security for payment. By way of recommendation of the scheme it is further stated that, "the line will not reach any other city of importance in the State of Nebraska, therefore its efforts will be devoted entirely to the building up of Lincoln." This is not a very good point for the promoters of the scheme to advertise if they have any desire to interest capitalists. These railroad projects which are gotten up for the purpose of booming real estate, often show a marvelous facility in leaking through the little end of the horn. If the projectors of the enterprise can raise the $4,000,000 or so, required for building their road among the patriotic citizens of Lincoln, they may succeed in their scheme. Otherwise it would be well to consider whether the proposed line has a reasonable chance of paying its operating expenses, and fixed charges when run in competition with its powerful rivals.

Grand Marais & Vermilion.—It is stated that surveyors are at work on this line in Northeastern Minnesota.

Duluth & Tower.—A direct line is projected from Duluth to Tower, to be 78 miles in length, a saving of 18 miles over the Duluth & Iron Range.

The Southwest.

Existing Roads.—The St. Louis *Globe Democrat* makes the following predictions concerning the construction of next season in Texas:

"The Chicago, Rock Island and Pacific will put in the entire year in building in the Indian Territory and Texas. The Fort Worth and Rio Grande will build 150 or 200 miles of road. The Fort Worth and Denver will be busy constructing its main line and branches, until the middle of the year. The St. Louis and San Francisco will build its air-line to Fort Worth. The St. Louis, Arkansas and Texas will complete its Commerce-Fort Worth and Corsicana-Hillsboro lines, and then take up its Chandler-Fort Worth line. The Fort Worth and New Orleans will shoot out southeast to the pineries. The Missouri Pacific will extend the east line from McKinney to Fort Worth, finish its line from Bastrop to Houston, and build its road to Hillsboro and Waco. The Fort Worth-Western will build to Springtown, Jacksboro and Graham. The Denison, Bonham and New Orleans will be at work all the year extending its lines. The Gulf, Colorado and Santa Fé will construct its Farmersville Fort Worth line, and will probably build other extensions."

Southern Pacific.—The officers of the company have offered to extend the Victoria branch of the Atlantic system from Victoria *via* Goliad to Beeville, Tex., a distance of about 60 miles, on condition that local aid is guaranteed to the amount of $75,000.

Union Pacific.—It is stated that the proposed line from McPherson, Kan., to Wichita has been given up, and a line is to be surveyed to Wichita from Topeka.——The Salina, Lincoln & Western extension has been opened for business from Lincoln Center to Waldo, Kan., a distance of 37 miles.

Batesville & Brinkley.—A reconnoissance has been made for the proposed extension of this Arkansas road to Pocahontas and Brinkley. It is probable that the extension will be undertaken next season, and the existing road will be changed to standard gauge.

Missouri Pacific.—The following statement of earnings and expenses for the first 9 months of the current year has been issued to the stockholders:

Gross earnings on 3,258 miles	$15,830,929
Operating expenses	9,426,338
Net earnings	6,704,591
Fixed charges	3,686,636
Three quarterly dividends	2,238,614
Surplus	659,333

The Bald Knob branch of the Iron Mountain road is completed to a point within two miles of West Memphis.——The Hillsboro, Tex., line is nearly graded and bridged from Dallas to Chamber's Creek, 44 miles and work is being pushed on the last 33 miles of the line.

Central Missouri.—On the 20 miles of graded roadbed tracklaying is to be completed this fall, but no more grading will be done till next season.

Atchison, Topeka & Santa Fé.—On the St. Joseph extension tracklaying has begun, and the line is to reach St. Joseph by Jan. 1.

Rocky Mountain and Pacific.

Existing Roads.—*Southern Pacific.*—About two miles of track has been laid on the Shingle Springs & Placerville road, and the whole 12 miles is expected to be finished by Dec. 1.——On the San Pablo & Tulare road 15 miles of track are down, and both tracklaying and grading are making rapid progress.——It is now definitely known that the construction on the gap between Templeton and Santa Barbara, which will complete the coast line from San Francisco to Los Angeles, will not be actively undertaken for some time. Several branch lines are rumored in Southern California, and the construction of the Goshen & Visalia road is to be pushed.

St. Paul, Minneapolis & Manitoba.—The last rail of the Montana Central extension to Helena, Mont., was laid at that city on Nov. 19. On Monday, the 21st, a great celebration was held, and the golden spike was driven, celebrating the completion of the Manitoba road from St. Paul to Helena, a total distance of 1,175 miles, of which 625 miles have been built since the beginning of the present season. The line from Helena to Butte, 73 miles, is under contract to Larson, Keefe & Co., to be completed by June 15, 1888. The Helena & Rimini road is to be ironed at once if the weather permits.

Chicago, Burlington & Quincy.—On the extension to Cheyenne, Wyo., the track is expected to reach that point by Dec. 1. It is currently rumored that the line will be built north from Cheyenne to connect with the Grand Island & Wyoming Central extension in Northeastern Wyoming.

Chicago, Rock Island & Pacific.—Surveyors are reported in the field, locating a line to Pueblo, Col.

Missouri Pacific.—Track is being laid at the rate of 2 miles per day on the extension to Pueblo, and is expected to reach that point by Dec. 3.

Denver, Texas & Fort Worth.—The line from Trinidad, Col., southeast to the coal fields, is to be finished within 30 days.

New Projects and Surveys.—*Lake Valley.*—This company has been incorporated to extend the road owned by the Carson & Tahoe Lumber & Fluming Co., in Eldorado county, Cal., a distance of 8 miles. A. J. RALSTON, of Oakland, Cal., is interested.

Denver & Golden.—This Colorado road, 13 miles in length, is to be completed and in operation by July 1, 1888.

New Projects and Surveys.—*New Orleans, Mexia, Cleburne & Northwestern.*—A company has been formed at Mexia, Tex., to build at a line to Cleburne about 75 miles.

Kansas City & Sabine Pass.—The company has filed a mortgage for $3,485,000 to the Union Trust Company of New York City.

Kansas City Cable Roads.—The cable system is being extended and new franchises are to be obtained. Mr. ROBERT GILLIAM is Chief Engineer of the Citizens' and Peoples' cable companies and of the Inter-State Rapid Transit Ry. Co.; Mr. W. B. KNIGHT is Chief Engineer of the Metropolitan Street Ry. Co.; Mr. BONTECOU is Chief Engineer of the Grand Ave. Ry. Co., and Mr. CLIFT WISE is Chief Engineer of the Kansas City Cable Ry. Co. The contemplated system will comprise 53.3 miles, the present condition of which is as follows: in operation, 15; under construction, 15.4; authorized, 4.8; projected, 18; total 53.2.